PHILIP SABIN

SIMULATING WAR

STUDYING CONFLICT THROUGH SIMULATION GAMES

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Philip Sabin

Continuum International Publishing Group
The Tower Building
11 York Road
London SE1 7NX

80 Maiden Lane
Suite 704
New York, NY 10038

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I could never have made such extensive and wide-ranging progress with conflict simulation techniques were it not for the ideas and inspiration provided by the work of hundreds of talented enthusiasts over the past five decades. The bibliography gives a sense of many of the people involved, but I would especially highlight James Dunnigan, Phil Barker, Richard Berg, Charles Vasey and Paul Rohrbaugh for their general contribution and their assistance to me personally. Paddy Griffith's prolific simulation designs and insightful scholarly studies of conflict dynamics have been a particular inspiration, and his death last year was a very sad loss. Peter Perla, Howard Body, Tom Mouat, Andrew Sharpe and John Curry have all helped me to develop my simulation activities, and have played significant roles in building synergies between professional and recreational wargaming. My own MA students have also taught me a lot as we have worked together on their simulation projects over the past several years, and here two names deserve special mention – Garrett Mills, whose project forms the basis of the jointly designed game *Roma Invicta?* in Chapter 9, and Arrigo Velicogna, who has given invaluable help to later cohorts of MA students and has been my main teaching assistant in undergraduate simulation classes.

I am grateful to several organisations for helping to make the book possible. The first is obviously the Department of War Studies at King's College London, where I have been based throughout the 25 years it has taken me to research and to develop my ideas on this unusual topic. The Society of Ancients and the Wargame Developments organisation have also provided longstanding inspiration, and it is well worth perusing their websites (http://ww.soa.org.uk and http://www.wargamedevelopments.org) to see what they have to offer. My thanks go to Pen and Sword Books and my former student Phil Sidnell for permission to quote an extended extract from Edward Grace's gripping memoir *The Perilous Road to Rome & Beyond*, and I am particularly grateful to NASA for making freely available on its website (http://visibleearth.nasa.gov/) the satellite imagery that I have used to provide a vivid backdrop for the simulation maps provided in the colour plates. As with *Lost Battles*, my main debt of gratitude with regard to the book's graphics goes to Dale Larson for his simple but ingenious freeware program *Cyberboard*, the many uses of which I describe in detail in Appendix 4.

Finally, I could never have completed this drawn out and time-consuming project without the love and support of my entire family, for which the book's dedication is but scant recompense.

To my Family

Introduction

‘In the whole range of human activities, war most closely resembles a game of cards.’[1] With that apparently bizarre statement, the early nineteenth-century Prussian officer Carl von Clausewitz, still regarded by most observers today as the greatest ever theorist of war, resoundingly confirmed the special relationship that has existed for millennia between war and games. The classical Greeks applied the same ‘agonistic’ spirit of competition to their athletic contests and to their endemic internecine wars.[2] Rome complemented its military ferocity with its addiction to bloody gladiatorial games, an institution that came back to haunt it during Spartacus’s revolt in the early first century bc, but which nevertheless plumbed new depths a century later when the spectacles even included entire mock naval battles (*naumachiae*) staged in artificial lakes or flooded arenas.[3] In medieval times, it was warriors rather than slaves who took part in martial duels in the form of tournaments, including *melées* that were often barely distinguishable from real battles.[4]

As Clausewitz’s remark suggests, less energetic and more cerebral kinds of game were also linked from the earliest times to the institution of war. Board games such as *Wei Hai* and *Chaturanga* are known to have been played in China and India well over two millennia ago, and *Chaturanga* in particular had a clearly military focus, with pieces depicting the four main arms of Indian warfare (infantry, cavalry, chariots and elephants), and with play governed by fixed rules and the roll of dice. *Wei Hai* and *Chaturanga* seem to have been the ancestors of games that remain pervasive to this day – *Go* and chess respectively. The relationship of these games to real warfare became increasingly stylised as military methods changed, but there were periodic attempts throughout the early modern era to devise more detailed and realistic miniature representations of combat, until Clausewitz’s own day, when another Prussian, von Reisswitz,

began the modern age of military gaming with the development of *Kriegsspiel*.[5]

What is it about war and games that has bound them together for millennia, despite the apparently stark contrast between the gravity of fights for survival and the frivolity of play? One need only watch play fights between young mammals such as cats to see that the contrast is in fact anything but stark. In his classic study *Homo Ludens*, Huizinga wrote that: 'Ever since words existed for fighting and playing, men have been wont to call war a game … Fighting, as a cultural function, always presupposes limiting rules, and it requires, to a certain extent anyway, the recognition of its play-quality.'[6] A decade ago, I took part in a fascinating interdisciplinary conference on the subject of war and games, and Tim Cornell wrote that: 'What finally emerges from the papers and ensuing discussions is the general idea that the various manifestations of ritualized war lie at different points on a continuum between the extremes of pure games and all-out war.'[7]

The key characteristic uniting war and games, and which sets them apart from most other human activities, is their competitive and agonistic nature. In games, this competition is mainly artificial, while in war it is mainly situational, but the effect is the same. Both war and games pit humans against one another in a dynamic interactive contest of wits and resources, as the opposing sides struggle to prevail. As Clausewitz succinctly put it: 'War is nothing but a duel on a larger scale.'[8] The centrality of this agonistic struggle gives war and games some key common features that distinguish both of them from other human endeavours, in which people are generally working more independently or cooperatively. US military theorist Edward Luttwak wrote that:

> [*T*]*he entire realm of strategy is pervaded by a paradoxical logic of its own*, standing against the ordinary linear logic by which we live in all other spheres of life (except for warlike games, of course). In settings where conflict is merely incidental to purposes of production and consumption, of commerce and culture, of social relations and consensual governance, with strife and competition more or less bound by law and custom, a noncontradictory linear logic applies,

> whose essence is captured by what we think of as commonsense.[9]

Luttwak cites numerous instances of the paradoxical logic of strategy, ranging from the Roman writer Vegetius's advice that, 'If you want peace, prepare for war' to the way in which military forces often deliberately choose difficult or circuitous routes to an objective. In Luttwak's words, 'Only in the conflictual realm of strategy would the choice arise at all, for it is only if combat is possible that a bad road can be good *precisely because it is bad* and may therefore be less strongly held or even left unguarded by the enemy.'[10] Examples of such paradoxical choices abound, such as the Allied decision to invade Europe via Normandy in 1944 rather than taking the more direct route via the Pas de Calais, and Germany's decisions in both 1940 and 1944 to attack westward through the tangled but ill-guarded forests and hills of the Ardennes.[11]

Sun Tzu, whose precepts on war still command enormous respect after over two millennia, sets out similar paradoxical principles, such as that: 'Invincibility lies in the defence; the possibility of victory in the attack.' He advises that: 'All warfare is based on deception. Therefore, when capable, feign incapacity; when active, inactivity … Offer the enemy a bait to lure him; feign disorder and strike him … When he concentrates, prepare against him; where he is strong, avoid him … Attack where he is unprepared; sally out when he does not expect you … These are the strategist's keys to victory.'[12]

Since games are one of the very few activities in which these distinctive characteristics of warfare may be mirrored, it is hardly surprising that there have been growing efforts to use games as a means of simulating in a safe and controlled environment some of the dynamics of armed conflict. As already mentioned, Baron von Reisswitz, a civilian adviser to the Prussian court at Breslau, managed in 1811 to obtain royal patronage for his *Kriegsspiel* game, which simulated military operations using a sand table containing a relief model of terrain, over which wooden blocks representing various military units were manoeuvred. Von Reisswitz's son later developed the game further with his brother

officers, and published the rules in 1824. Soon afterwards, General von Muffling (who had been Wellington's Prussian liaison officer at Waterloo a decade earlier, and was now Chief of the General Staff) watched a demonstration. Although initially sceptical, the General famously exclaimed at the end, 'This is not a game! This is training for war! I must recommend it to the whole army.'[13]

Over the ensuing two centuries, the armed forces of most nations came to employ various forms of wargaming for training and planning purposes as a matter of routine, alongside more traditional activities such as field exercises. This military use of wargaming, especially its heyday in the United States during the Cold War, has been discussed by many authors over the years.[14] I will return to the subject in Chapters 3 and 4, but my focus in this book is instead on analysing and employing another, less well-known form of modern wargaming, which I surveyed in my own contribution to the academic conference I mentioned earlier on War and Games.[15]

Over the past 50 years, many thousands of different wargames have been published around the world, not for professional use by military officers and defence analysts, but for interested individuals to employ as a means of studying the campaigns concerned and experiencing some of the *frisson* of duelling for victory. Although some of these games focus (as do military wargames) on current or potential future conflicts, the great majority of them cover battles or campaigns of the recent or distant past. As a result, there are now few conflicts across the whole of military history on which there does not exist at least one published wargame, and on some famous battles such as Waterloo, Gettysburg, Stalingrad, D-Day or the Bulge, there are 20 or more each.[16] Although this profusion of games is still dwarfed by the veritable flood of military history books which have appeared over the same period, the difference is not utterly overwhelming, and for a number of battles or campaigns, it is actually the case that the most detailed published treatment of at least some aspects of the engagement will be found not in a book but in a wargame.[17]

These wargames are of various types, with three types being particularly prominent. The first, and most numerous, consists of **board games**. Wargames of this sort contain a gridded map representing a real battle area, and printed counters representing real military units. There is also a set of rules and charts to govern the operations of units on the map, just as the rules of chess provide a structured context within which players may employ their pieces as they see fit in their struggle to prevail. Some board wargames come in boxes or ziploc bags, while others are folded within magazines such as *Strategy & Tactics*, *The Wargamer*, *Command*, *Vae Victis*, *Against the Odds*, *World at War* or *Battles*, which usually also contain historical essays to provide background on the particular engagement being simulated.[18] It is board gaming that is the main focus in this book, since it makes up the bulk of the recreational wargaming corpus, and since (as I discuss in Chapter 2) it offers the greatest accessibility for the creation of new tailored simulations.

The second main type of wargame consists of **figure games**. These take the form of a set of rules with which players may fight various tactical battles on the tabletop, using model terrain and miniature figures that they purchase separately. Although figure games are often used to refight particular historical engagements, they also often involve imaginary scenarios, especially where the main emphasis is on creating an equally matched competition between players. Similarly, although some figure games use a gridded table, it is much more common to employ freeform rules using tape measures. Large battles are simulated by varying the ground scale and by treating each figure as representing tens or even hundreds of real troops.[19] Figure games look spectacular, but they are very costly and time consuming to produce and are mainly confined to the tactical level, so I will not say much about them in this work. However, this branch of the hobby has produced some very insightful ideas and research that are of great applicability to conflict simulation in general. Especially noteworthy in this regard are the ‘Wargames Research Group’ led by Phil Barker and the ‘Wargame Developments’ organisation with its journal *The Nugget*, as well as more period-specific groups

such as the ‘Society of Ancients’ with its journal *Slingshot*, which has been published continuously since 1965.[20]

The final main type of wargame consists of **computer games**. It is now fairly straightforward and common to convert the map and counters of board wargames into digital images that may be displayed instead on the computer screen, but computer games proper involve programming the rules into the software as well, so that they are applied automatically. Artificial intelligence routines can also be devised to provide a computer opponent, as in Chess programmes.[21] The boundaries of computer wargaming have become increasingly fuzzy, since they shade into the much more popular *genres* of real-time strategy games and real-time first person combat simulators covering everything from infantry and tanks to warships and fighter aircraft.[22] Computer games are now so dominant overall that most people who hear the word ‘simulation’ automatically assume that this must be computer based. I will say quite a lot in this book about computer wargames and about the potential that networked computing has opened up, but a key argument will be that computerisation has costs as well as benefits, and that the best way forward lies in a judicious and flexible balance of old and new technology.

So why is this massive corpus of wargames not better known? One reason is that wargames are significantly less accessible than books, which almost anyone can browse through or read. It takes considerable time and intellectual effort to learn and to play most wargames, so only enthusiasts of the *genre* tend to try. The physical characteristics of wargames compound the problem of accessibility, since their maps and die-cut counters or computer disks mean that it is very rare for bookshops or libraries to stock them. They are produced by specialist games companies rather than mainstream publishers, sold by direct mail or through specialist games retailers rather than by traditional or online bookstores, and reviewed by specialist games magazines such as *Fire & Movement*, *Paper Wars*, the French journal *Vae Victis* or the very impressive new publication *Battles*, rather than by academic or popular journals.[23] As a result, they are little known outside a narrow community of enthusiasts, and are very rarely

even mentioned in conventional literature on the battles or campaigns that they cover.[24]

This ignorance and inaccessibility is further compounded by widespread prejudice. The terms ‘game’ and ‘play’ carry inescapable intimations of frivolity and childishness, and the term ‘wargame’ makes matters even worse by suggesting to the uninitiated that devotees are reducing the tragic sacrifices of armed conflict into some form of amusement. Wargames enthusiasts hence tend to be very reticent in public about their activities, and to cloak them in euphemisms such as ‘conflict simulation’.[25] Quite a few prominent writers on military history are themselves wargamers, but you would not know it from their published books.[26] Most scholars ignore or dismiss wargaming, for reasons I explore in Chapter 1.[27] Games in general suffer from a deep-rooted perception of juvenilia, as illustrated by the remarkably limited attention and respect that the entire modern video games industry receives in the print and broadcast media, despite having a turnover larger than Hollywood.[28] As Jane McGonigal put it: ‘Almost all of us are biased against games today – even gamers. We can’t help it. It is part of our culture, part of our language, and it’s even woven into the way we use the words “game” and “player” in everyday conversation.’[29] Given this pervasive prejudice, it is hardly surprising that the much more specialist niche activity of wargaming is so neglected and misunderstood.

Why, then, is it even worth studying this shadowy world of recreational wargaming? There are already a number of books which survey the activity, almost all of them produced by enthusiasts themselves. Some works, like those by Allen and Perla, interweave the development of professional and recreational wargaming.[30] Others, such as the books by Dunnigan, Berg, Freeman and Palmer (until recently a British member of parliament) focus on how to play and design board wargames.[31] Rex Martin’s doctoral thesis provides a long and detailed sociological overview of the first four decades of US board wargaming.[32] There are literally dozens of books on the alternative approach of fighting tactical battles with model

soldiers.[33] Most of these various works are now rather dated, and there is certainly a need for a more up-to-date survey, especially to review the latest developments in computer wargaming and how these have affected the more traditional approaches of board and figure gaming. However, my aim in this book is not to provide just such an updated survey, but also to suggest that creative application of the analytical techniques developed by wargames enthusiasts over the past half century offers some novel and powerful tools for teaching and research in the strategic studies field.

Building on the work of enthusiasts rather than that of their more 'respectable' professional counterparts might seem perverse, but in fact it offers three overwhelming advantages. First, recreational wargames are far more numerous and easily available, since they are published openly and not constrained by problems of security classification. Although most older wargames are out of print, those covering a particular topic of interest may now be identified and purchased online through eBay or specialist second-hand dealers, just as with out of print books. Second, if one's main focus lies in military history (as does mine), then recreational wargaming is really the only game in town, since professional wargamers are understandably preoccupied with modelling current and potential future conflicts. Third, whereas professional wargaming has been for many years predominantly computer based (not least because it looks more scientific and avoids the stigma of openly rolling dice to generate random variation), recreational wargaming has maintained a better balance, with new board wargames being published today at a greater rate than ever before (albeit in much smaller volumes).[34] As I will discuss in Chapter 2, the old technology still has much to offer, especially in an academic context where resources and technical skill are less readily available.

One reason for the lack of scholarly research on recreational wargaming (unlike for other popular *genres* such as war novels and war films) is that the mass of games and magazines the hobby has generated cannot be found in traditional libraries and archives. I have only been able to research and write this book because I have collected my own personal copies of several

thousand such publications throughout my three decades at King's College London's world-renowned Department of War Studies. This book hence represents the culmination of a major research project that I have been undertaking for my entire scholarly career. It builds also on the very considerable experience that I have now amassed in applying the techniques I have studied, through designing my own specially tailored simulations and through getting my military and civilian students to play and design such simulations for themselves. I have found the analytical insights that wargaming can provide, through its mirroring of the dynamic interactivity and paradoxical logic of real war, to be invaluable for both research and teaching in the war studies field. I will endeavour in this book to explain why that is, and to help wargamers and non-wargamers alike to gain similar benefits themselves in the future.

The book is divided into three parts. In Part I, I discuss the **theory** behind the academic potential of wargaming techniques. Chapter 1 develops a clearer definition of what wargaming actually entails, and sets the activity in the context of other analytical approaches such as game theory, operational research, mathematical modelling, role-playing exercises and counterfactual history. Chapter 2 then grapples with and tries to resolve one of the most fundamental tensions within wargame modelling, that between accurately capturing the complex details of a real conflict and keeping the simulation simple enough to be understood and played in a reasonable time. Chapter 3 goes on to discuss the utility of wargames as an educational device, by reviewing how military wargaming has developed since the days of *Kriegsspiel*, assessing the often fraught relationship between professional and recreational wargamers, and exploring various more or less ambitious ways of using simulations in class, based on my own experience teaching both military and civilian students. Finally Chapter 4 addresses the two-way linkage between simulation and research, outlining the peculiar demands and challenges of acquiring the data needed to underpin a wargame, and showing how simulations themselves can contribute to research by highlighting neglected questions, illuminating complex interactions and providing a more robust framework for comparative studies

like the one in my own previous book, *Lost Battles* (itself just republished with deluxe components for ease of use).[35]

In Part II, I move on to outline the **mechanics** of designing simple tailored simulations of any desired conflict, drawing on techniques developed by wargames enthusiasts and defence experts over the past 50 years. Chapter 5 discusses how the inordinate complexity of real terrain and military forces may be reduced to a manageable level using generic weightings and categorisations, a grid system, and an appropriate level of unit subdivision. Chapter 6 explains how the physical processes of movement, combat and logistics may be modelled by techniques such as quantification, random variation and the division of time into successive 'turns'. Chapter 7 asks whom the players represent, and outlines how good and poor generalship, command delays, intelligence and the fog of war may be modelled through judicious use of the sequence of play, hidden units, and artificial intelligence. Then, in Chapter 8, I discuss the vexed issue of how best to balance luck, skill and historicity within wargame design, and I go on to explore the use of handicapping and victory incentives and to outline the different styles of rules writing and the role of playtesting and validation in helping to refine the final simulation.

Part III is the real heart of the book, with three long chapters, each filled with detailed practical **examples** of how I have used the principles set out earlier to design and run a range of educational wargames within my various courses. Chapter 9 discusses my use of simulations (such as those contained in *Lost Battles*) in my teaching on ancient warfare. The chapter includes two other complete games that I have used in this context – a multiplayer political simulation of the *Second Punic War* and *Roma Invicta?*, an operational study of the first two years of Hannibal's campaigns in Italy, which was originally designed by one of my MA students. Chapter 10 moves on to consider my teaching on World War Two, and my use of simple grand strategic simulations of the *Second World War* and the *Eastern Front*, both available online for free download. The chapter contains complete versions of two other games that I use in class to illustrate the more detailed operational dynamics of air and land warfare at the

start of 1944 – *Big Week*, which covers US bombing raids from England and Italy, and *Hell's Gate*, which simulates the battle of the Korsun pocket in Ukraine. Finally, Chapter 11 focuses on my use of more generic tactical simulations, and explains how simple board games can still hold their own even here alongside the real-time computer simulations that I also employ to give students a more vivid understanding of tactical dynamics. The chapter includes a further three complete games based on tactical combat in the Second World War – *Fire and Movement*, which simulates an attack by a British infantry battalion, *Block Busting*, which models a smaller scale attack in the specific context of urban warfare, and *Angels One Five*, which covers the interception of an escorted bomber formation.

The book concludes by drawing the threads together and exploring the considerable potential for greater academic and military application of wargaming techniques, based on a study day that I was commissioned to run on this subject at the UK Defence Academy just before the book was completed. There are then five appendices filled with further practical guidance. Appendix 1 explains how to construct the maps and counters for the games in Part III, either by cutting out the colour plates or by downloading and printing out separate copies from the book's website. Appendix 2 advises on how best to identify, find reviews of and obtain copies of published simulations of a chosen conflict, and includes a wide range of helpful weblinks. Appendix 3 provides a basic refresher on some of the simple mathematics associated with wargame design, focusing on proportionality and probability. Appendix 4 covers *Cyberboard*, a freeware graphics program that I use routinely to produce my own simulations, and which allows people to use digitised versions of the map and counters of many published board wargames (including those contained in this book). Appendix 5 provides full instructions for my game *Kartenspiel*, which builds on Clausewitz's analogy mentioned earlier, and which allows up to 10 players to refight a generic Napoleonic battle in 15 minutes using nothing more than a single pack of cards.

You should feel free to use the book in whatever way you find most helpful. If you are already a wargamer (whether amateur or

professional) you should be able to jump straight in and play the simulations in Part III, which (despite their relative simplicity) contain a number of innovative design concepts and offer accurate and challenging reflections of the conflicts concerned. Non-wargamers will probably prefer to start with the generic introductions in Parts I and II, and to begin with the simple games in Chapter 3 and Appendix 5, but you should also examine the games and look at the illustrated examples of play in Part III as soon as possible, since abstract theory can be hard to grasp, and there is no better way to understand a technique than to see its application in a specific case. The simulations are designed to be significantly easier, quicker and more accessible than the great majority of published wargames, so playing them is the best way of avoiding being turned off at once on exposure to the detail and complexity of standalone products. I hope that it will not be too long before you are inspired to try creating your own simple simulation designs. Teachers and instructors at all levels will be able to employ simulations in class to bring the tactics and strategy of conflicts vividly to life, while researchers will find that expressing their interpretation in terms of a simulation model raises all sorts of questions which might never otherwise have arisen. However the book is used, if it makes you think, and sparks even a few ideas, it will have more than served its purpose.

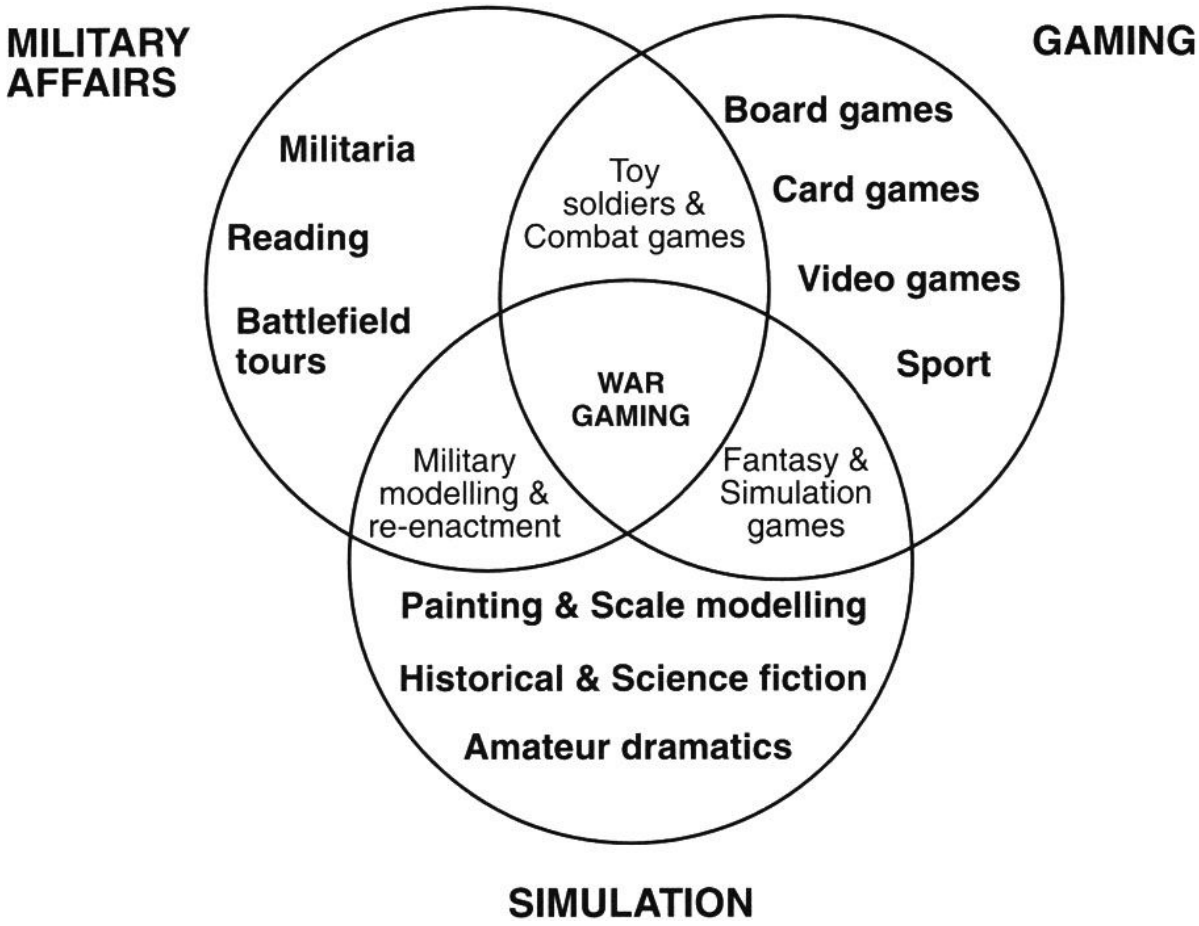
PART I

Theory

1

Modelling war

So what exactly is a wargame? James Dunnigan, who founded Simulations Publications Incorporated in the 1960s and has been the hobby's leading designer and commentator ever since, wrote pithily that: 'A wargame is a combination of "game," history, and science. It is a paper time machine. Basically, it's glorified chess.'[1] Peter Perla, a US Navy analyst whose integrated study of professional and recreational wargaming offers by far the best theoretical overview of the entire *genre*, provided a more scholarly definition, as follows: '[A] wargame is a warfare model or simulation whose operation does not involve the activities of actual military forces, and whose sequence of events affects and is, in turn, affected by the decisions made by players representing the opposing sides.'[2]



1.1 Relationship of wargaming to other recreational activities

When I myself sought to explain recreational wargames to an academic conference on 'War and Games' a decade ago, I found it best to define them as 'military simulation games', lying at the intersection of three broad areas of leisure interest (see Figure 1.1). I went on to explain that: 'They are based on the military capabilities of some past or present antagonists, and entail a degree of research to ascertain the key characteristics involved. They attempt to simulate aspects of a real or imaginary armed conflict involving such military forces, and to do so with at least some concern for accuracy or "realism." Finally, they do this in the form of a game, which players can win or lose by making decisions which need not be the same as those of the actual commanders.'[3]

Such military simulation games are made up of two fundamental components. The first is an underlying mathematical model of reality, which seeks to simulate the terrain of the battle area, the deployment and capabilities of the military forces, and the passage of time during the engagement, thereby providing a

synthetic experimental environment that mirrors in certain key respects the real range of potential courses and outcomes associated with the armed conflict concerned. The second, equally fundamental, component of military simulation games consists of an iterative set of active decision inputs by one or more players to guide the simulated actions of the combatants, and to respond to the changing course of the simulated conflict, in order to maximise their relative or absolute performance in terms of artificial victory criteria established to reflect the real measures of success and failure associated with the actual engagement. It is this combination of mathematical modelling and active decision inputs that gives wargames their unique potential as a source of insight into armed conflict, since the combination mirrors the dual character of war itself as a set of physical realities in terms of force capabilities that is given life only by the interacting strategies of the competing antagonists.

Just as recreational wargaming lies at the nexus of a whole range of associated leisure interests, so the twin components of wargaming place it in the midst of a range of techniques used by academics, defence analysts and military officers to try to model the complexities and enigmas of warfare. Some of these techniques focus more on mathematical modelling of military forces, while others concentrate more on the decision element. I will now briefly review the various associated techniques, to give a clearer sense of where wargaming stands in relation to them. I will then ask why wargaming has until recently been used so little in the academic study of warfare compared to other techniques of mathematical modelling or decision analysis, despite apparently offering the best of both worlds.

Let me start by discussing the vexed question of terminology. In this book, I use the terms ‘simulation’ and ‘game’ almost interchangeably, since (as I just explained) I see wargames as an intrinsic blend of the two techniques. Some scholars prefer to draw a sharp distinction between the two concepts, and to confine the term ‘simulation’ to detailed self-contained systems that faithfully mimic real processes without the need for human intervention, whereas ‘games’ are much more unpredictable and heuristic activities.[4] By this definition, wargames as a whole are very clearly ‘games’ rather than ‘simulations’, but along with many others, I

disagree with attempts to outlaw the hybrid concept of ‘simulation games’.[5] Some academics have suggested using the alternative term ‘serious games’ to reduce the stigma associated with gaming, but this is worse than useless for my purposes, since it implies that recreational wargames are, almost by definition, ‘not serious’.[6]

Schlenker and Bonoma summed up the problem very well when they wrote that the challenge was: ‘to impress upon researchers and students that games are simply tools useful for developing theories and testing hypotheses. They are experimental vehicles, not isomorphic simulations of the real world and not merely frivolous endeavors allowing researchers to relive the playful moments of their childhoods.’[7] The authors suggested finding another term altogether that did not carry the baggage of either ‘game’ or ‘simulation’, but since the only alternative term which has won any acceptance is the problematic one of ‘serious games’, I prefer to stick with my more descriptive hybrid concept of ‘military simulation games’. Dunnigan, as usual, made the pithily appropriate comment that: ‘A wargame is a playable simulation. A conflict simulation is another name for wargame, one that leaves out the two unsavory terms “war” and “game”.’[8] On a related note, I will also use the term ‘model’ more broadly and colloquially than in its official military sense, where it denotes only a small component such as an equation or algorithm.[9] I much prefer my King’s College colleague Willard McCarty’s view that: ‘[A] model is by nature a simplified and therefore fictional or idealized representation, often taking quite a rough-and-ready form: hence the term “tinker toy” model from physics, accurately suggesting play, relative crudity, and heuristic purpose.’[10]

With that terminological issue addressed, let me begin my review of associated methodologies by examining mathematical modelling. As I mention in my book *Lost Battles*, one can find instances as far back as antiquity of writers such as Thucydides and Polybius using mathematical calculations to explore the relationship between the numbers, depth, spacing and frontage of troops within a battle line.[11] Mathematics came into its own in siege warfare, especially during the Enlightenment when experts such as Vauban were reputedly able to calculate months in advance exactly when fortresses would fall, based on calculations

of how long it would take to dig the necessary trenches and conduct the necessary bombardments.[12] At the end of the eighteenth century, von Bülow tried to extend such calculability to the strategic level when he argued that: ‘The agency of military energies, like the other effects of nature, becomes weaker … in an inverse ratio of the square of the distance’ and hence that none of the eleven large European states would be able to conquer another. Napoleon soon brutally demonstrated the speciousness of his reasoning, and Clausewitz became a devastating critic of such mathematical determinism that failed to take proper account of human factors in the conduct of war.[13]

It was in the twentieth century when mathematical modelling of combat really got into its stride. A key early figure was Frederick Lanchester, who in 1916 published an analysis of the new field of air warfare. In Chapters 5 and 6, he developed his famous ‘N-Square’ law, in which he argued using basic differential calculus that the key factor in modern combat was concentrating superior numbers at the decisive point. His argument was that an initial numerical advantage during an exchange of fire between troops of equal individual effectiveness would be magnified inexorably over time, since the more numerous hits inflicted by the already larger force would compound its proportional dominance and create a vicious downward spiral for its opponents. Hence, a force of 1000 should in theory annihilate one of 500, while losing only 134 men itself. Lanchester argued that splitting an enemy force into two roughly equal halves and fighting each one in succession with one’s whole force should hence allow even an initially outnumbered antagonist to triumph, and he cited Nelson’s battle plan before Trafalgar as a prime example of aiming to defeat the enemy in detail in this way. He did, of course, recognise that the effectiveness of individual elements was not in reality equal, and so he suggested that: ‘The *fighting strength* of a force may be broadly defined as proportional to *the square of its numerical strength multiplied by the fighting values of its individual units*.’[14]

Unfortunately, Lanchester’s model contains several highly dubious assumptions. It makes no allowance for the density of troops increasing their exposure to fire, whereas we know that dispersion has been a key factor in limiting casualty rates as

weapons have become more and more effective.[15] His model has all shots aimed at surviving enemy forces, rather than inflicting multiple redundant hits on the same targets or even hitting friends who have been misidentified. It assumes that opponents fire simultaneously, and that each shot has only a small chance of hitting its target. More realistic assumptions in any of these areas could easily erode the square law altogether or even give the advantage to the smaller force (especially if it fires first). On the other hand, Lanchester's model assumes that overmatched troops continue to fire with unchanged effectiveness even while being ground down to utter annihilation, rather than taking cover, fleeing or surrendering without even inflicting the limited enemy casualties that his model predicts.

Depending on how these offsetting flaws balance out, real combats could vary wildly in either direction from Lanchester's simplistic deductions. Scholars have produced a mass of studies over the past century elaborating Lanchester's equations and trying to see if real casualty data from battles such as the Ardennes or Iwo Jima conform to the patterns he described.[16] However, his model is so artificial that any resemblance to reality is bound to be largely coincidental, especially since there is no clear way of calculating the varying 'fighting values' of opposing forces except by working backwards from the combat results themselves. As I will discuss in Chapter 9, his alternative 'linear' model of hand-to-hand fighting in ancient times is even more problematic, since real casualty ratios then were often ten or even 100 to one instead of the roughly even butcher's bills which his model predicts – paradoxically, it was only with the advent of gunpowder weapons more suited to his square law that more balanced casualty rates began to develop.[17]

What makes this issue of crucial importance to the present study is that Lanchester's model is a far better predictor of the behaviour of simple simulations and games than it is of real combat, because the simulations and games often share the same simplistic assumptions. For example, in the very first wargame that I ever played, a duel between opposing squads of riflemen at a range of 300 yards would on average produce impeccably Lanchestrian results, since the rules laid down that every man

would hit a chosen enemy on a die roll of 6 in each one minute turn.[18] Even professional wargames and simulations, for all their sophistication, often have Lanchester's equations at their heart, and hence offer at best a vague approximation of real engagements depending on whether his offsetting errors happen broadly to cancel out.[19] Ironically, it is in his own field of air warfare where his model comes most grievously unstuck, as I will show in Chapter 11. In that Chapter, I will also illustrate how more sophisticated wargame modelling of the effects of dispersion, on the one hand, and the suppressive effects of superior firepower, on the other, can yield a much more credible representation of modern land combat than does Lanchester's square law.

Where mathematical and scientific thinking about war did come into its own in the early twentieth century was through the rather different techniques of 'operational research' (or 'operations analysis' as it was termed in the USA). The story has often been told of how scientists such as Tizard and Blackett assisted the Allied cause in World War Two by gathering and analysing data from technical experiments and real military operations, and by using these data to suggest more efficient and effective ways of fighting the war. Notable triumphs of this close relationship between scientists and the military included radar-directed fighter interception during the Battle of Britain, more effective aerial interdiction of German U-Boats as they crossed the Bay of Biscay, and safer and more effective bombing of Germany using concentrated bomber streams guided by Pathfinders and radio aids.[20]

After the war, operations research became an entire scholarly discipline in its own right, and developed complex mathematical and computing techniques to model and to help streamline and improve procedures across the full range of societal activity.[21] In the field of defence, the focus of modelling during the Cold War shifted away from real ongoing combat operations towards the simulation of potential nuclear or conventional conflict between NATO and the Warsaw Pact. Gallons of ink were spilled on these hypothetical scenarios, to try to discern whether NATO had any chance of holding its own in a conventional war without resorting to nuclear escalation, or whether either side was at risk of a nuclear

‘counterforce’ strike that would destroy most of its own weapons before they could be fired. The models were mostly purely mathematical with no active human decision input, since their object was to gauge the technical capabilities of the two sides without the unsettling randomness and variation that human players would have introduced. Thankfully, such a nightmarish conflict never materialised, so we will never know what relationship the models bore to reality.[22]

The Vietnam War presented the civilian systems analysts in McNamara’s Pentagon with a less theoretical modelling challenge, but they notoriously failed to master guerrilla warfare with anything like the success that operational researchers had achieved during the more conventional contest of World War Two.[23] Western nations have faced similar intractable challenges in the Balkans, Africa, the Middle East and South West Asia since the end of the Cold War, and professional modellers have made efforts to expand their simulations to take greater account of the political factors that are now so crucial.[24] However, the ‘comfort zone’ for mathematical analysts is still high intensity warfare as in the Gulf War of 1991, and recent modelling literature below the strategic level remains very similar to 30 years ago. What has changed over time is the sophistication of the modelling, with the most glaring weaknesses of simple Lanchestrian formulae being explicitly addressed so that professional models do now offer challenging and thought-provoking attempts to come to grips analytically with the profound complexities of the combat experience.[25]

Although the primary focus of professional defence analysts is modelling current and potential future conflict, they do often research recent historical engagements in order to validate their models. Such historical studies tend to be very valuable for wargame designers, since they focus more than most works of military history on quantitative statistical data. As I will discuss further in Chapter 10, Swedish defence analysts Zetterling and Frankson have produced some very useful analyses of World War Two battles such as Kursk and Normandy.[26] My colleague and friend Ian Gooderson did his doctorate with me on World War Two air support while researching this subject from contemporary operations research reports for the Historical Analysis team in the

UK's Ministry of Defence.[27] David Rowland, a leading member of that team, has since published a tactical study of land combat based on data from trials and historical experience, and he arrives at some fascinating model-based conclusions about human performance and combat outcomes.[28] I will now discuss the work of two other analysts whose mathematical modelling of past conflicts has achieved even greater prominence.

The first is retired US Colonel Trevor Dupuy, a prolific author on general military history, who in 1979 published his 'Quantified Judgement Model' which sought to derive from reams of combat data since Napoleonic times a comprehensive set of formulae to take account of 73 variables in land warfare ranging from terrain and weather to leadership, weaponry and air support.[29] Dupuy expressed his ideas more clearly a decade later in his book *Understanding War*, which was once again full of graphs and tables covering such things as advance rates and casualty rates. His central idea was that the combat power of a force could be calculated as the product of its force strength, combat effectiveness value, and environmental and operational situation, with each of these three overall values being based on many subordinate considerations as in his earlier identification of 73 relevant factors.[30] Dupuy then cross-referenced his calculated combat power ratios with the observed outcomes of past conflicts, and reached conclusions such as that the superior side did indeed often achieve disproportionate success as Lanchester had argued (although interestingly Dupuy also identified the contrary phenomenon of diminishing returns from overwhelming superiority).[31] The central problem with his methodology is, of course, that the presence of so many variables and intangibles makes the 'fudge factor' in calculating combat power quite enormous, so the predictive power of his model remains limited. One controversial aspect of Dupuy's calculations is his finding that certain nations such as the Germans or the Israelis have performed consistently better man for man than their opponents, a finding supported by a number of other studies.[32]

The other prominent analyst who has applied mathematical modelling techniques to past conflicts is Stephen Biddle.[33] In his 2004 book *Military Power*, Biddle adopted a much less ambitious

approach than Dupuy, and focused his efforts on a detailed analysis of just three specific twentieth-century land offensives – Operation Michael on the Western Front in 1918, Operation Goodwood in Normandy in 1944, and Operation Desert Storm in 1991.[34] His work is full of graphs, tables and formulae, and he assesses key variables such as force ratios, force densities, defensive depth, casualty rates and advance rates. His central argument is that victory in modern battle depends much more on the doctrine and tactics that the antagonists employ than on material factors such as the balance of men and equipment. Hence, the German infantry in 1918 achieved stunning initial advances thanks to their stormtroop tactics, despite having less of a preponderance in men and material than the Allies in their bloody offensives over the previous two years. By contrast, massive Allied numerical superiority in tanks and aircraft did not allow them to achieve a breakthrough in Operation Goodwood. Biddle's emphasis on qualitative rather than quantitative factors tallies with Dupuy's stress on similar variables, and casts further doubt on Lanchester's simplistic focus on numerical concentration within battle itself as the decisive factor. That being said, the Allies did defeat Germany in the end in both world wars, so being able to mobilise superior resources overall to replace earlier attritional losses does seem to have key in the end, as long as one could learn from initial defeats and improve one's own doctrine and fighting effectiveness accordingly.[35]

In 1944, von Neumann and Morgenstern published their pioneering *Theory of Games and Economic Behavior*, and so established the related analytical technique of 'game theory'. The book expresses in complex formulae and equations the characteristics of various different kinds of game (such as Poker) between two or more players, and analyses the dynamics and optimum strategies of these games so that the best 'plays' to take advantage of the interactive choices available may be calculated mathematically without actually needing human players to take part. Von Neumann and Morgenstern discuss in great detail the impact of variables such as chance variation and limits on the information available to the players, and they make the very important distinction between 'zero-sum games' (in which one player's gain is the other's loss) and 'non-zero-sum games' in

which the total payoff for the players may vary so that there is an incentive for cooperation as well as competition as they try to maximise their overall profits (or minimise their losses).[36]

As the title suggests, the book itself was aimed at casting new light on economic behaviour, but it was not long before operational researchers sought to apply game theory to their own modelling of military conflict. In 1954, Haywood used game theoretic models of naval operations in the Bismarck Sea and of the American breakout from Normandy to discuss the vexed question of whether it was better for commanders to base their plans on enemy capabilities or intentions (although it has since emerged that the 'Ultra secret' played a significant role that he could not know at that time).[37] Other researchers employed game theory to study problems such as the optimum routing of convoys to avoid submarine attack, or the optimum allocation of air effort among the various missions such as counter-air attacks, air defence and close air support during an ongoing air/land campaign.[38] Economist Robert Kuenne used systems analysis techniques to model the entire US and German submarine offensives in World War Two, showing how closely linked the various modelling approaches became.[39] However, in his 1960 book on *The Strategy of Conflict*, economist Thomas Schelling took the military application of game theory in a new and broader direction.[40]

Whereas von Neumann and Morgenstern spent most time discussing zero-sum games, Schelling was much more interested in simple two player non-zero-sum games in which all the players had to do was to make a simultaneous choice between two (or occasionally more) available alternatives. This was because Schelling was writing at the very time when the United States was trying to come to terms with the advent of 'mutually assured destruction' as the USSR developed its own massive nuclear arsenal. In this unprecedented situation of a bipolar superpower standoff in which all-out conflict would be mutually suicidal, prior military wisdom based on the experience of the world wars seemed redundant, and civilians such as Schelling came forward to try to make sense of the new strategic environment.[41] Central to their insights was a symmetrical game summarised in the matrix in Figure 1.2. Each superpower had a simultaneous choice between

taking a hawkish or a restrained stance, and the payoff that each nation received depended on how its own choice interacted with that of its opponent, as shown in the four boxes of the matrix.

	US stance is hawkish	**US stance is restrained**
Soviet stance is hawkish	Both sides lose	USA loses, USSR wins
Soviet stance is restrained	USA wins, USSR loses	Both sides win

1.2 Game representation of superpower rivalry

The key feature of this non-zero-sum game is that either superpower will gain an advantage from adopting a hawkish stance if its enemy is more restrained, but that both will be worse off in the case of mutual hostility than in the case of mutual restraint. By manipulating the relative numerical payoffs associated with the different boxes, Schelling and similar theorists sought to model three different kinds of superpower competition. One was the nuclear arms race, in which both sides continually built up their arsenals based on worst case planning about ongoing enemy weapons production, but in which both could benefit if they could trust the adversary to display mutual restraint (for instance, through arms control agreements). The second situation was a crisis or limited war, in which threats of escalation could secure a favourable resolution for the more hard line protagonist, but in which mutual hawkishness might trigger Armageddon. The final and most nightmarish scenario was one in which the vulnerability of both side's nuclear arsenals to a first strike created a 'reciprocal fear of surprise attack', such that the least bad option was to fire first even though the 'victory' this produced would in this case be far inferior in value to that obtainable by avoiding nuclear war altogether.[42]

Schelling's work was far more accessible than that of von Neumann and Morgenstern, since instead of arcane formulae he used homely analogies such as likening superpower 'brinkmanship' to a contest of 'Chicken' between teenage boys driving towards one another on a narrow road. His 1966 book *Arms and Influence* did not include a single matrix or equation.[43]

He nevertheless managed to derive some subtle and disturbing conclusions from his analysis, including the merits of appearing reckless so that the adversary would feel that it was up to him to avert catastrophe, and the way in which issues of reputation and commitment across successive plays of the game could come to outweigh the immediate payoffs at stake in that round alone. During the crises over Berlin and Cuba, it looked for a while as if the darker side of Schelling's theories were coming true, but thereafter the superpowers were shocked into focusing on the more cooperative elements in the system, by ensuring that secure second-strike capabilities were maintained and that the arms race was defused through arms control.[44] In the real and highly asymmetric conflict in Vietnam, Schelling's theories on tacit bargaining and on the merits of gradually inflicting coercive pain proved less successful, although whether the results would have been much better with a rapid US bombing campaign to shock the North Vietnamese into compliance is dubious to say the least.[45]

Over the succeeding four decades, game theoretic approaches have continued to be applied across the entire field of international relations and conflict studies, as well as beyond.[46] After the first flush of enthusiasm, doubts soon emerged about the legitimacy of comparing the choices made by stressed, biased, ill-informed and fragmented military or political bureaucracies with the decisions of rational, amoral, unitary 'players' concerned only with maximising their payoff in an artificial game.[47] However, defenders of game theory such as Bennett and Shubik argue that these limitations may be at least partially addressed through a combination of devising subtler and more complex game models and integrating game theoretic approaches more with other techniques for the study of international conflict.[48] An interesting recent debate among game theorists concerns the merits of Steven Brams's 'theory of moves', which suggests that alternate choices rather than simultaneous ones as in Schelling's classic model would better capture the reality of international politics.[49] As I will discuss in Chapter 7, this has interesting parallels with the debate among wargamers over the pros and contras of alternate and simultaneous turns when simulating a military contest.

Rather paradoxically, the games around which game theory revolves are rarely actually played by human participants.[50] It is a very different story with the common heuristic technique of 'role playing', which is intended expressly to give individuals the feel of being 'in the shoes' of real decision makers. I myself used such role playing in my first university classes over 20 years ago, with students grappling with politico-military decisions such as whether to drop the atomic bomb in 1945, what to do about the Soviet missiles in Cuba in 1962, or whether to sink the Argentinian cruiser *General Belgrano* in 1982. I still remember the feeling of satisfaction when, during a similar role play on how the USA should respond to Viet Cong guerrilla activity in 1964, a previously quiet Zimbabwean student piped up and said: 'Well I have been a guerrilla fighter myself, so I think I have something to offer.'! Our sessions were simply discussions among undifferentiated 'advisers', but a common refinement is to give players individual roles with unique goals and interests, in order to encourage bargaining and coalitions.[51] Role playing can work well as long as the participants study the background properly beforehand, but it is best at simulating dilemmas facing groups of people who have more common than competing interests. It is not suited to modelling outright conflict or even the dynamic progression of a situation, since there is no mechanism (other than the *fiat* of the facilitator) to move things along or to determine which side prevails. This is where wargaming has much more to offer, as I will show in Chapters 3 and 9.

Let me turn finally to the most common way of all in which scholars, military officers and defence analysts seek to model conflict, namely through the use of the written and spoken word. It may seem odd to describe books, articles and lectures on war as 'models', but that is exactly what they are. In themselves, they are quiet, inoffensive activities that bear even less direct resemblance to the horrible reality of war than do Hollywood audio-visual spectaculars such as *Saving Private Ryan*.[52] By triggering ideas and images in the minds of readers and listeners, they seek to convey an impression of just a few very limited aspects of the overwhelming human experience and tragedy that war represents. Whether they are primary sources such as unit records or

individual memoirs, secondary sources such as historical accounts, or analytical studies such as military doctrine manuals or works of strategic theory, these various collections of words do indeed 'model' war from their own particular perspective, just as mathematical models, films and wargames do in their own individual ways. One need only compare the very different images of the battle of Stalingrad conveyed by Antony Beevor, with his focus on the human dimension, and David Glantz, with his concern for military detail, to see how much depends on the necessarily selective priorities of the authors themselves.[53]

One tiny subset of the almost unimaginably vast literature on war is of particular interest for our present purposes, namely speculative or 'counterfactual' studies. There has been a long tradition of novelistic predictions of how a future war might be fought, sometimes intended for didactic effect to encourage changes of policy in the present.[54] H.G. Wells, for instance, captivated and scared readers before both world wars with his novels *The War in the Air* and *The Shape of Things to Come*.[55] During the second half of the Cold War, military men such as Hackett produced detailed imaginary accounts of a potential conventional war in Europe, as I discussed in my own doctoral thesis at the time.[56] Since 1991, writers like Dupuy have created a much more wide-ranging set of 'future histories' of potential conflicts in various locations around the world.[57] Even more interesting for our present purposes than such 'future history' is speculation about how events might have gone differently in the past. There is quite a long tradition of such speculation (as in the 1929 book by another King's College professor, F.J.C. Hearnshaw, on *The 'Ifs' of History*), but it is only recently that 'counterfactual' studies have become a prominent publishing phenomenon.[58]

Some of these counterfactual works take the form of entire books focused on a single alternate strand of history (typically set during World War Two). They include Stolfi's argument that Germany could have defeated the USSR in autumn 1941 by attacking Moscow rather than Kiev, and Grigg's case that D-Day should have taken place in 1943 rather than 1944.[59] There are also entire fictional narratives that take as their starting point a key change such as the fall of Moscow or the Axis capture of Malta, or

which focus in detail on slight tweaks that give battles like Gettysburg, D-Day or the defence of Britain in 1940 a completely different outcome.[60] More common are single authored or edited books in which each chapter covers a different 'turning point' or counterfactual episode, usually all drawn from the same war, but sometimes spanning the whole of military history.[61] Famous historians such as Niall Ferguson and Andrew Roberts have embraced the counterfactual *genre*, and have edited books with contributions by other eminent authors on possibilities ranging from the victory of the Spanish Armada or the avoidance of the American Revolution to the survival of Soviet Communism.[62] In Ferguson's words: 'The past – like real-life chess, or indeed any other game – is different; it does not have a predetermined end.'[63]

This proliferation of counterfactual speculation has provoked interesting reactions among other professional historians. Some (like Andrew Roberts and Jeremy Black) have cast it in ideological terms, as a triumph for free thinking over determinist left-wing sceptics such as E.H. Carr and E.P. Thompson.[64] There has been some open criticism of the counterfactual approach, and many other traditional historians seem to take a silently dismissive view.[65] Perhaps the cruellest putdown of counterfactualism came inadvertently from my colleague Mervyn Frost, who thanked Jeremy Black for a talk explaining 'why what happened didn't happen'![66] However, a surprising number of scholars have sought to engage with the theoretical issues raised. One common view (which I very strongly endorse) is that counterfactual history is merely the other side of the coin from traditional analytical history, since one cannot ask why an event happened and whether it was bound to do so (as in Richard Overy's classic study *Why the Allies Won*) without admitting the possibility that it might not have occurred.[67] Avoiding such questions altogether would lead in the end to history becoming a mere narrative chronicle of events, with no real attempt to explain the causes of what happened or to illuminate the dynamic underlying mechanics.[68] This would be the very antithesis of the other modelling approaches outlined in this chapter, wargaming above all.

Several scholars, such as Richard Ned Lebow, have sought to develop a theoretical methodology for counterfactual speculation,

going beyond the rather vague and impressionistic frameworks in the counterfactual studies themselves. One conclusion is that evidence is of critical importance, and that the better documented the underpinnings of the historical event, the more convincingly one can estimate what the impact of specific changes might have been. A second point is that pattern building and comparisons with similar events can be helpful, since they offer a way of offsetting the uniqueness of the event itself. A third observation is that there is a distinction between 'plausible' and 'miraculous' changes to reality, and that the more easily it is possible to imagine a change actually occurring without requiring other complex antecedents, the more securely one may speculate about the overall effect. A fourth point is that proper attention must be paid to the likelihood that any change will trigger further consequential changes – these might magnify the disruption through a chaotic 'butterfly effect', or they might on the contrary damp down and offset the initial perturbation and so return later events to something more like their historical course.[69] I shall return to these considerations in Chapter 4, since they are of fundamental importance for the design of credible wargame simulations.

So where does wargaming fit in to this whole broad sweep of scholarly and professional modelling of warfare? As I will discuss in Chapters 3 and 4, military officers and defence analysts have long used wargaming techniques routinely for both training and research purposes, alongside the other approaches I have outlined. In academia and civilian education, it has until recently been a very different story. Whereas operational research, game theory, role playing and even counterfactual history have all become well-established scholarly techniques within the fields of military history, strategic studies and international relations (alongside the core methodologies of archival research, analytical writing, lectures and seminar discussions), one would scarcely know from twentieth-century academic literature that wargaming even existed. Glick and Charters did write an article in 1983 advocating the use of wargaming techniques by military historians, and a few teachers experimented with using their hobby wargames in class, but such initiatives never really caught on.[70] Most scholars and educators were either completely ignorant of

wargames or saw them as an inappropriate vehicle for the study of war.

Exactly why this should be is not easy to discern, given the silence on the matter in past academic and educational literature.[71] Ignorance and misperception are entirely understandable, given the self-conscious reticence of wargaming devotees and the classified nature of professional wargaming. As I have shown, the word ‘game’ is a further encumbrance, especially since most existing wargames have indeed been designed by ‘amateur’ enthusiasts for recreational use, and so are not clearly distinguished from the worlds of toy soldiers and fantasy gaming. Air historian Dr Alfred Price reported that, until he saw a wargame in action, he ‘had a rather fuzzy pre-conceived notion that wargamers were grown-ups who played around with kids’ toys, and tried to make out that they were making some serious contribution to military understanding in the process’.[72] Many observers do not appreciate the degree of detailed research behind some published wargames, and instead are misled by the use of dice into comparing them with pure games such as Ludo or Risk. If they do actually examine commercial simulation games, they often lurch to the opposite extreme and dismiss them as impossibly complex and unplayable. Operational researchers may be put off by the apparent lack of rigour in wargame research and modelling, while traditionalist scholars in the humanities may see wargames as combining the worst features of game theory and counterfactual history.[73] Finally, civilian studies of war have tended in the past to focus more on political, social and economic aspects such as the ‘causes and consequences’ of conflicts than on the detailed strategic and tactical conduct of operations on which wargamers and military professionals tend to concentrate.

This combination of factors creates powerful reasons for pessimism about academic attitudes to wargaming techniques. However, recent developments do offer significant reasons for hope. The rise of computer strategy games has exposed vastly more people to the experience of gaming, and so reduced the stigma and misunderstanding from which it suffered in the past. A 2010 survey in the United States found that 97 per cent of youngsters played computer and video games, but that the

average game player was 35 years old and that a quarter were over 50.[74] Whereas the very rare televising of three manual wargames in the UK in 1997 was described by one reviewer as, ‘A ghastly flop – but very funny’, seven years later the more televisually oriented PC game *Rome: Total War* spawned a television show called *Time Commanders*, which ran for two full series.[75] Educators at all levels have proved similarly receptive to the potential contribution of computer simulation games, and there is now considerable academic literature covering the burgeoning use of commercial or purpose designed computer games to help teach everything from history to science.[76] Studying the actual conduct of war has become more common than in the anti-military academic climate of the Vietnam era, and the growing tolerance for contingent and counterfactual approaches also bodes well.[77] Commercial PC strategy games have been integrated into a number of history courses, and Niall Ferguson has repeatedly advocated their use in education and has himself helped to develop one such product (*Making History*).[78] Even manual wargames are now used by several teachers including me, and I hope that my own longstanding and positive experiences as detailed in the rest of this book will inspire still more to follow our example.[79]

The bottom line is that wargames have the potential to unite every single one of the diverse techniques now used for modelling war within a single integrated approach. They contain dynamic mathematical models of military forces and terrain, just like those produced by operational researchers. They confront decision makers with a complex and ever changing series of interactive, game theoretic choices and dilemmas. They place individuals into roles paralleling those of real commanders, and encourage vibrant discussions within teams as to the best strategies to adopt to defeat real rather than hypothetical opponents. They present their information not through complex formulae and data tables but in words and battle maps, just like ordinary books on the campaign concerned. Finally, they contain as their very essence a dynamic explanatory model rather than a simple linear narrative, so that hypothetical and counterfactual alternatives emerge automatically as players ‘experience history’ and gain deeper insights into why

the real campaign proceeded as it did.[80] This does not mean that wargames can in any way replace or supersede these individual approaches to the study of war, but it does mean that they can offer valuable supplementary insights as long as their accompanying limitations can be overcome through the kind of measures which I will now move on to discuss.

2

Accuracy vs simplicity

Perhaps the most pervasive trade-off affecting all human attempts to understand the world in which we live is that between accurately capturing the almost infinite complexities of reality and keeping our models simple enough to be grasped by ordinary minds and used as a practical guide for action. Even natural scientists face this tension, as illustrated by the continuing practical dominance of Newtonian mechanics despite the fact that relativity, quantum mechanics and chaos theory now encompass a much broader range of physical phenomena.[1] Social scientists and historians face an even sharper trade-off between accuracy and simplicity, since human behaviour is far more complex and unpredictable than that of inanimate matter, and since controlled experimentation to investigate the impact of individual variables is much harder with human subjects (especially when dealing with past events or with such a traumatic and deadly phenomenon as war).[2] As I discussed in Chapter 1, the theories of Lanchester and Schelling illustrate very well how basic models are often too simplistic to capture properly the observed reality of conflict dynamics.

Wargames are particularly severely affected by this trade-off between accuracy and simplicity, for two principal reasons. First, although (as I said at the end of Chapter 1) wargames have the virtue of combining most other modelling approaches into one, the downside of this eclecticism is that the complexity of each component approach is even further constrained if the overall complexity of the entire wargame model is not to exceed tolerable limits. Second, whereas some modelling techniques need only be understood properly by experts, with their conclusions being at least to some extent ‘taken on trust’ by lesser mortals, wargames are by their very nature participatory devices in which users need

to have a certain understanding of the mechanics in order to benefit from the model at all. It is hence not surprising that the issue of where to strike the balance between accuracy and simplicity (or, as it is usually put, between realism and playability) has been one of the most enduring and vexed debates within the wargaming hobby.[3]

It might reasonably be expected that recreational wargamers would veer more towards the playability end of this spectrum than do their more 'serious' professional counterparts. Veteran figure gamer Donald Featherstone did indeed state explicitly that: 'The object of the exercise is enjoyment and relaxation coupled with a mild intellectual stimulation … It should be realised from the very beginning that it is a game we are playing which can, for obvious reasons, bear only the most superficial resemblance to anything that takes place on a real-life battlefield.'[4] However, another veteran figure gamer, Charles Grant, took exactly the opposite view when he argued that: '[R]ealism in the rules governing movement, firepower and melee is an absolute essential for any war game worth playing, and … in such a game there can be no doubt but that events on the table should be a true and complete reflection of what occurred in reality.'[5] The board wargames on which this book is primarily focused tend to aspire to realism at least as much as playability, and journalist Thomas Allen found Mark Herman's recreational boardgame *Gulf Strike* more impressive in this regard than an official game he took part in on the same subject the following year.[6] In Allen's words: 'I found it hard to believe that it was his game that was supposed to intrigue hobbyists – and the war college's game was the one that was supposed to inspire informed thought about US strategy in the Middle East.'[7] Even more striking was the reaction of renowned Vietnamese General Vo Nguyen Giap when sent a copy of Paul Rohrbaugh's hobby simulation of Giap's 1954 victory at Dien Bien Phu. Far from dismissing this game, Giap played it with his old colleagues such as General Tranh, and ordered several more copies for inclusion in local museums and divisional archives.[8]

Why is it that recreational wargame designers are often at least as concerned as their professional counterparts to make their games 'realistic', despite the unavoidable costs in terms of

playability and the research efforts required? The principal reason seems to be that (as I discussed in Chapter 1) wargames lie at the nexus of popular interest in military affairs, simulation and gaming. Hence, both designers and players are often more concerned with the 'military simulation' parts of the endeavour than with the 'game' aspect for its own sake.

Nothing could better illustrate this prioritisation than the fact that surveys consistently show that most playings of board wargames occur on a solitaire basis, with a lone player controlling each side in turn.[9] There are many dozens of books and games and even an entire journal (*Lone Warrior*) dedicated exclusively to such solo play, and almost all board wargames offer just two indicative ratings to potential purchasers – one showing their complexity, and the other showing how easy it is to adapt the system for solitaire use.[10] One need only consider the very limited appeal of playing a pure game such as chess or Monopoly solo to see where the real interest in recreational wargames lies. Dunnigan wrote that: 'By far the most common reason gamers give for playing the games is to experience history', since, 'almost all simulation games contain four general kinds of information: geographical, Order of Battle, situational, and dynamic potential'.[11] With hobbyists being motivated primarily by the attraction of seeing certain aspects of an actual or potential conflict 'come to life' in their hands, one can understand why wargame designers sacrifice realism at their peril.

The problem with recreational board wargames is less that they are too simplistic for serious students of conflict than that they are insufficiently simple and playable for most people to understand and use without disproportionate expenditure of time and effort. Dunnigan described board wargaming as 'the hobby of the overeducated', with over half of feedback respondents in the early 1990s having postgraduate degrees and over sixteen years of education.[12] Just as has happened in the fields of game theory and operational research, wargame systems have tended to become significantly more complex over time, as users have mastered the fairly simple initial techniques of the 1960s and early 1970s and introduced greater subtleties to try to make their models more realistic.[13] Commercial pressures have compounded

the problem, since it is easiest to charge high prices for a wargame if it contains masses of components and can be portrayed as the most detailed and sophisticated treatment of its subject, even if this means that it takes dozens of hours to learn and play and is really only suitable for ‘solitaire study’. Just as bibliophiles buy many more books than they actually read, so wargamers often content themselves with browsing through the rules and maps of their games to experience what Dunnigan calls their ‘dynamic potential’ – this is fine with the publishers as long as the sale is achieved.[14] Magazine games today usually have a few hundred counters and 20 to 30 closely typed pages of rules and charts, and some boxed wargames have thousands of counters, and maps covering 20 or more square feet of table space.[15] One reviewer reported that it took him 20 hours just to set up the counters for a recent massive game on D-Day![16] Even experienced wargamers blanch at such ‘monsters’, while to non-wargamers who are used to games such as chess with just a few dozen pieces and one or two pages of rules, the size, complexity and duration of published wargames are almost unbelievable.

Some wargame companies have sought to respond to this problem and to bring new blood into the ageing hobby by publishing radically smaller and simpler introductory ‘microgames’.[17] Minden Games, Victory Point Games and the French magazines *Battles* and *Vae Victis* have all recently made a specialism of such small designs, and the US magazine *Against the Odds* has gone to the extreme of producing several free promotional games in which the rules, map and counters are crammed onto the two sides of a postcard.[18] Such microgames remain as yet on the fringe of the wargaming hobby, but several dozen have been published over the past few years, and they continue to appear at a rapid rate.[19] I will argue later in this chapter that wargames of this scale, if properly researched and carefully designed, offer the ideal compromise between accuracy and simplicity when seeking to bring wargaming insights to bear on the wider study of conflict. First, however, I must discuss the development that has reduced board wargaming as a whole to a mere shadow of its former self, namely the inexorable rise of computer games.

As long ago as 1992, Dunnigan wrote that: ‘In the past 15 years, computers have increasingly displaced paper as the format of choice among wargamers.’ He added that:

> [W]hile annual sales of manual wargames amount to a few hundred thousand units (and dropping each year), computer wargames sell over half a million units a year (and are rapidly increasing). If you include the simulator-type games (aircraft, vehicle and others), several million computer wargames are sold each year. Computer wargame sales keep climbing as more powerful computers make these simulators even more impressive, easy to use, and attractive to people who would previously not have wanted to hassle with the traditionally (and unavoidably) complex wargames.[20]

These trends have continued apace over the succeeding two decades, and whereas an individual board wargame would now be lucky to sell more than 2000 copies, the most successful computer wargames (such as the *Call of Duty* series) achieve unit sales in the tens of millions when one includes the versions for consoles such as Playstation and Xbox.[21]

As Dunnigan suggested, a major attraction of computer games is that they offer a way of minimising the trade-off between detail and playability, at least as far as the player is concerned.[22] Modern computers and consoles can calculate the mechanics and ballistics of an entire battle in real time, so that players hardly even need to read any rules before jumping into the vivid 3D world to control their own personal ‘avatar’, just as if they were stepping into a war movie.[23] The software contains artificial intelligence (AI) routines to handle the behaviour of non-player entities or to control opposing forces, thereby making solitaire play possible without the schizophrenic need to command each side in turn. Computer games can also directly simulate the fog of war by limiting the information provided to each player, without the problems which this entails in manual games (as I will discuss in Chapter 7). Whereas one reason for the dominance of solitaire play in board wargaming was the difficulty of finding like-minded opponents in the local area, the internet now allows networked

play of computer or console games, sometimes involving dozens of players at once from around the globe, taking different roles in the same battle.[24]

Some computer wargames combine the capabilities of the PC with the seriousness of board wargaming to create the best of both worlds. A leading example is the series by Panther Games covering several famous battles in World War Two.[25] This series does away with artificialities such as turns and a hexagonal grid, and instead depicts units moving and fighting continuously across a realistic digital map of the natural terrain, with their formations varying depending on how the troops are deployed at any given time. Commanders at all levels on both sides are simulated by AI, allowing players to adopt the role (and blinkers) of a specific real commander rather than having to handle every single unit manually as in boardgames. There is even a 'realistic' option for purists in which orders from a high-level player commander may take many hours to come into effect, because of the cascade of more detailed planning required of their numerous AI subordinates – a factor highlighted in professional military wargames of that era.[26] Several other PC games adopt similar techniques to model military operations and to simulate command choices and the fog of war in other historical battles and campaigns from the nineteenth century onwards.[27] The computer clearly has enormous potential utility in this regard thanks to its automatic data-processing capability, and one can easily see why professional military wargamers have embraced the new technology so completely and why the recent rise in educational gaming has been almost entirely computer based.

So why in this book do I take the apparently perverse course of refusing to dismiss board wargames as ancient history, as most writers on computer gaming tend to do?[28] Surely it would be better to follow Niall Ferguson's lead in his *Making History* project and to forge links with a software development house in order to produce automated games more suited to the twenty-first century?[29] As I will discuss further in Chapter 11, I have nothing at all against computer wargames, and I have used them in my classes for many years, going well beyond traditional educational practice and setting some groundbreaking precedents in this

regard. However, to set against their manifold potential advantages, computer games have a significant number of practical and theoretical limitations relative to the older technology of board wargames, especially as a vehicle for the civilian study of war. I outlined these shortcomings in a paper on 'The Benefits and Limits of Computerisation in Conflict Simulation', which I delivered at a major international academic conference on 'Digital Humanities' in July 2010, and which has just been published in a leading scholarly journal.[30] I will now reprise the arguments that I develop in this paper, to show why I prefer a more balanced mix of old and new technology.

First, the great majority of computer and console games about warfare focus far more on entertainment than on realistic simulation. This applies especially to mass market products such as the *Call of Duty* or *Medal of Honor* series, which simulate escapist action movies rather than real warfare, and in which players gun down dozens of enemies while recovering from any wounds they themselves may suffer by finding 'health packs' or even by just lying for a few seconds behind a wall.[31] Beyond the first-person tactical level, most computer wargames take the form of 'real-time strategy games', which are abstract duels of unit construction and resource management with only a thin patina of historical realism, as shown by the anachronistically massed phalanxes of troops, tanks and planes that such games usually depict.[32] The mass appeal of certain computer wargames hence comes at a very stiff price for our present purposes, since most have the same selective and instrumental attitude to historical accuracy displayed by Hollywood movies such as *Braveheart* and *U-571*.[33] There are exceptions such as the *Hearts of Iron* and *Making History* series, which offer a complex if rather artificial and broadbrush geopolitical model of world conflict in the 1930s and 1940s, incorporating factors such as diplomacy, ideology, industrial mobilisation and natural resources as well as mere territorial conquest.[34] However, such games work better as impressionistic multiplayer politico-economic studies than as simulations of the strategy and tactics of real military conflicts, which is what I am most concerned with in this book and in my own teaching and research.[35]

Second, even among more serious and specialist computer wargames (discounting for a moment real-time 3D simulators), only a small minority exploit the unique capabilities of the PC to the same extent as do products such as the Panther Games series. Most of the rest are essentially computerised versions of boardgame systems, with the same hexagonal grids and successive turns.[36] Although programming the rules into the software does help to reduce the burden on the players, this is usually offset by the temptation to make the game system even more detailed and complex thanks to the PC's capacity to cope with all the extra calculations required. Hence, the manuals of serious computer wargames tend to be just as long and intimidating as those of board wargames, and the games take at least as long to complete, with players still expected to exert direct control over the actions of dozens or even hundreds of separate units. Far from being seen as a burden, this is portrayed as an asset, just as in 'monster' board wargames. The back cover of Gary Grigsby's simulation of South Pacific naval warfare in World War Two boasts that, 'The attention to detail in *Uncommon Valour* is breathtaking – every ship's captain and aircraft pilot is individually rated for their skills and experience and every weapon, plane and ship is accurately re-created from years of historical research.' The playing time required for this game is estimated by its makers at between 20 and 'hundreds' of hours.[37] Ian Trout and his colleagues make the equally telling claim that their own 'Decisive Battles combat system faithfully reports all aspects of a battle to you as the commander. This allows you to make fully informed decisions before a battle, and to determine whether a particular outcome was the result of generalship or luck.'[38] Clearly, these computer game designs are shaped less by the capabilities of the medium than by the preferences of the target audience as regards aspects such as the span of command and the fog of war.[39]

This leads on to a third limitation of computer wargames, namely that the unprecedented capabilities of the platform tend to encourage designers to focus on fancy graphics and on creating a 'bottom up' simulation incorporating all the relevant quantifiable inputs such as the technical performance of military hardware.

Manual game designers are perforce more inclined to aim for a simpler ‘top down’ approach that concentrates instead on overall outputs and observed effects, and which hence gives greater credit to the much less quantifiable human dimension.[40] Even the most graphically stunning computer simulations of ground or air combat typically produce grossly inflated mutual casualty rates, whether the combatants are controlled by the AI or by multiple real individuals playing across a network. In games ranging from *Rome: Total War* to the flight simulator *Il2* and the modern combat simulation *Operation Flashpoint* (described by one PC magazine as ‘the best war game ever made’), *melées*, firefights or dogfights end after just a few minutes of frenzied carnage, with all of one side and most of the other side dead.[41] This is not because the weapons modelling is wrong, but because the combatants (even if controlled directly by humans) have nothing like the incentive for caution and self-preservation that they would feel if the blades, bullets and shell splinters were real. Some recent computer games have made progress in this regard by having the combatants take cover or flee automatically (regardless of player orders) if sufficiently hotly engaged, but manual games have been achieving the same effect for decades thanks to their more top down design approach.[42] I will illustrate in Chapter 11 how simple boardgames can capture the overall tactical dynamics of land and air combat at least as well as do networked first-person computer simulations.

A fourth serious constraint affecting computer wargames is that they are very sensitive to the technical characteristics of the operating platform. The latest games will not run at all except with the latest processors and graphics hardware, while older games quickly cease to work as new operating systems appear. Whereas board wargames from the 1970s are still just as playable today as they ever were (often more so than their modern successors!), the hundreds of early computer wargames listed by Dunnigan in his 1992 book are now essentially lost for ever, as they simply will not run on modern systems.[43] Since the trend over time has been towards fewer, individually more complex and bigger budget computer games because of the growing design effort needed to take advantage of increasing system capabilities, the result is that

the entire corpus of board wargames outnumbers currently accessible computer wargame titles by at least a factor of ten, with no sign of the ratio diminishing in the future. This paucity and evanescence of computer wargames might not be so bad had the AI become as capable as it already has in chess programmes, but AI still lags well behind the stunning graphic quality of modern PC wargames, since it is much more difficult to model the nuances, subtleties and heuristic nature of real human decisions.[44]

A fifth problem with computer wargames is that they do not always offer striking advantages as a means of presenting information in an educational context. For real time 3D simulations of dynamic action, computers are of course unbeatable, and it is here where I make most use of them in my own teaching. However, when the object is to portray units positioned on a map, computer monitors and data projectors are actually less effective than physical maps and counters on one or more large tables, since their fixed resolution and limited field of view frustrates employment of the human eye's wonderful combination of central acuity and breadth of vision. It also takes at least as long to manipulate units on screen as it does to move physical counters. Computers have much greater potential if each person has his or her own dedicated machine allowing individual perspectives and inputs within an entire networked simulation, and this is exactly how military users of computer wargames tend to operate. However, resource constraints in civilian education make such lavish dedicated facilities with their massive technical support requirements hard to afford, so there is much to be said for the 'cheap and cheerful' alternative of gathering students around tables in the traditional manner, as shown at the start of the colour plates. When using simulations in my own studies, I much prefer employing physical components, despite the ready availability of digitised portrayals of the same information using a system such as *Cyberboard*.

My sixth and most fundamental reservation about computer wargames is that their vaunted 'accessibility' has very severe limits, and is, in fact, distinctly double-edged. They fall squarely into an 'expert-led' paradigm in which the design team expends great labour and ingenuity producing a complex artefact that large

numbers of users can employ without really needing to know what is going on ‘under the hood’. In McGonigal’s words: ‘The modern history of computer and video games is the story of game designers ascending to very powerful positions in society, effectively enthralling the hearts and minds – and directing the energies and attention – of increasingly large masses of people.’[45] Manual wargames, by contrast, require all users to understand and apply the designer’s system for themselves if the game is not to remain an inanimate pile of paper and card. This obviously requires a lot more intellectual effort from users, just as playing a piece of sheet music requires more effort and understanding than playing a CD, but it also makes the dynamics of the process much more open and explicit, giving users the scope to add their own interpretations and improvisations, and in the end perhaps to produce entire compositions of their own. Dunnigan’s most important single insight on manual wargames is that, ‘If you can play them, you can design them.’[46]

Comparing computer wargaming with the entirely passive activity of listening to a CD is, of course, rather unfair, since even the most easily accessible PC and console games still require a certain level of input and understanding on the part of the player. Many computer wargames now include the facility for users to tweak parameters for themselves or to develop new or amended scenarios using an intuitive game editor. Norm Koger’s *Operational Art of War* is designed entirely as a ‘sandbox’ for such user generation and online sharing of scenarios covering any modern battles desired.[47] However, the fact remains that modifications beyond those explicitly allowed for by the designer require formidable programming expertise to deconstruct the original code, while producing an entire computer wargame from scratch is an extremely daunting and time-consuming project, as indicated by the many dozens of different contributors listed in the credits of such games. By contrast, individual users can easily amend any desired aspect of a manual wargame simply by rewriting the rules paragraph concerned. Designing and distributing entirely new board wargames is also much simpler today than it has ever been, thanks to increasingly capable and accessible computer graphics programmes and the ability to

share or sell designs online at virtually no cost, for users to print out for themselves.[48] Manual wargames hence offer the only real means for non-technical individuals such as historians to gain a critical personal understanding of simulation techniques and to progress seamlessly into creating their own tailored simulation designs.

Why does it matter so much that wargame design should remain ‘democratised’ and should not become the sole preserve of those rare individuals or teams who combine advanced computer programming skills with an interest in military simulation? One reason is that, without the broad accessibility and top down focus of manual wargame design, computerised conflict simulation risks becoming an even more arcane and detail-obsessed science. As Dunnigan said, ‘To design a decent computer wargame, it’s still safest to go back to a manual design first’.[49] A second reason to resist the ‘expert-led’ character of computer wargames is that designing one’s own tailored simulations offers a far better way of studying conflict than simply playing existing commercial designs ‘off the shelf’. Despite the fact that many thousands of different manual and computer wargames have been published over the last 50 years, it has been my experience that dedicated designs with a carefully judged balance of accuracy and simplicity provide by far the best results both in terms of teaching and research. Although studying existing published wargames is a vital first step, it is not in itself enough. Explaining this view will be one of my main aims throughout the rest of this book, and I will start now by returning to the vexed issue of the trade-off between accuracy and simplicity.

Perla wrote of the ‘overriding necessity of … integrating realism and playability in a delicate balancing act designed to achieve a well-understood and well-chosen objective’. He went on to say that: ‘A wargame must be interesting enough and playable enough to make its players want to suspend their inherent disbelief, and so open their minds to an active learning process. It must also be accurate enough and realistic enough to make sure that the learning that takes place is informative and not misleading.’[50] These are very difficult requirements to achieve within a single design, and a useful starting point is to realise how

easy it is to fail in *both* respects. My former student, Andrew Mulholland, recently wrote a lengthy comparative review of seven published wargames on the American Revolution. His rather dispiriting conclusion was that only the most detailed game deserved a 'good' rating for historicity in even three of his five categories (politics, naval operations, supply and attrition, combat, and command and control), whereas the two simplest games failed to achieve a good rating in any of the five.[51] Since even these simpler games are still too lengthy and complex for use in class, the sheer difficulty of achieving realism and playability at the same time becomes very evident.

Board wargames do have one big advantage in terms of accessibility compared to the equations and formulae used by operational researchers and game theorists, namely that their mathematical models are expressed far more in words than in numbers. This is an enormous asset for humanities students and scholars, for whom maths is often a blind spot thanks to the gulf between the 'two cultures' of arts and sciences, as identified by C.P. Snow half a century ago.[52] Although Biddle's recent book *Military Power* has attracted widespread comment, Sir Lawrence Freedman was certainly not alone when he admitted in a lengthy review article that he had accepted the author's invitation to skip the denser theoretical chapters.[53] Wargames do not raise such delicate issues, since they are regularly played and even designed by people with no mathematical background whatsoever beyond vague memories of the very basics from schooldays (of which I offer a reminder in Appendix 3 should it be required). Wargames, like war itself, are thus a fascinating blend of art and science, and offer a welcome means of bridging the gap between Snow's two cultures. This does not make it any easier to strike a balance between accuracy and simplicity, but at least it means that no intelligent individual is excluded from the attempt altogether by virtue of their lack of the relevant mathematical background.

Both accuracy and simplicity are, of course, subjective concepts that are very much in the eye of the beholder. Designers tend to view their own creations through rose-tinted glasses in both respects, which is why it is so important to take on board the

experience of others (as I will discuss further in Chapter 8). Playing time is an especially variable factor, since it depends heavily on the experience and thoughtfulness of the players concerned. One fascinating article by a prison inmate (!) in Virginia in 1980 analysed no fewer than 138 playings of Dunnigan's simplest simulation of the Battle of the Bulge, which has just 100 counters and six pages of rules. The time taken for a complete game ranged from 1.66 hours between two experienced players to 9.25 hours between two players new to wargaming.[54] I wish that I had read this analysis before I myself tried to use the same game in class some years ago, leaving it to the students to proceed at their own pace. Sure enough, they were still trying to complete the first of eighteen turns after nearly an hour of play. I learnt then that only 'microgames' are remotely practical as an educational vehicle, and that one should never leave players to their own devices without constant guidance and chivvying from a more knowledgeable individual, except in the very simplest of games.

So does this mean that any hope of realism must be jettisoned in the overriding quest for speed and simplicity? In spite of Mulholland's comparative review, I do not think so. Even the smallest wargames have a mechanical subtlety that makes Lanchester's and Schelling's models look simple in comparison. The trick is to exploit this potential to the maximum extent, by devoting at least as much research and design effort to a microgame as is normally expended on a full size simulation. Commercially, this approach would be a disaster, since there would be no hope of such a small game commanding a price at all commensurate with the effort invested, given the fetish for detail evinced by most wargames enthusiasts. However, as a scholarly technique, it has a great deal to recommend it. Not only are the resulting games less intimidating to non-wargamers, but they also demonstrate how just a few dozen counters and a few pages of rules can recreate real command dilemmas and mirror the pattern of real battles and campaigns with astounding fidelity. The examples of play in Part III illustrate exactly what I mean.

There are, of course, sacrifices associated with foregoing the complex rules and hundreds of distinct units that traditional

manual or computer wargames contain, but these sacrifices are not as great as one might think. As designer Joseph Miranda remarked: 'The problem is, many wargame concepts are simply abstractions which have no obvious relation to reality … Nobody asks the basic question, does this type of elaboration really enhance understanding of war … or does it only enhance understanding of wargames?'[55] Players may like the feeling of detail and control associated with finely grained maps across which they manoeuvre hordes of individual units, but if this detail goes beyond the available evidence or if small-scale tactics are governed more by wargaming abstractions such as the 'alternate hex defence' (see Chapter 5) than by real military tactics, then not much is really lost by moving to a radically quicker and more broadbrush portrayal. The microgame approach has the positive advantage in terms of realism that games can be tested over and over again to reveal unexpected problems, and that interested users can play games repeatedly to explore the range of variation, rather than becoming distracted or dissatisfied midway through (or often before even starting) a single trial of a larger game, and so laying it aside for ever.

The fetish for wargame detail and complexity famously reached its greatest extreme in 1979 with *The Campaign for North Africa*, a multiplayer monster with five big mapsheets, 1800 counters, and nearly 200 pages of rules and charts that seemed to cover every conceivable logistic and tactical consideration.[56] It is said that not even the designers themselves had time to complete the full campaign game. One later reviewer wrote that: 'This game is just too involved to be played by a small wargame club with finite resources', but that it might be 'instructional to a graduate history seminar'.[57] Nothing could better illustrate the growing disconnect between the dwindling band of traditional wargames enthusiasts and the rest of society over what 'playability' really means. There is a reason why a popular game such as chess has only 64 grid squares and only 32 pieces, of which each player may move only one per turn. That is quite enough to generate subtleties and complexities that have engaged the greatest minds for many generations. One does not need to go much beyond these parameters to produce wargames

that offer challenging and thought-provoking simulations of real military campaigns. The great majority of published manual and computer wargames are, unfortunately, too complex, time consuming or unrealistic to be used directly in an academic context, but they do offer a mine of ideas on which one's own more tailored designs may be based. Above all, it is crucial to remember that a simple wargame that is played will be more instructive than a detailed wargame that is not.

3

Educational utility

The most important function of wargames is to convey a vicarious understanding of some of the strategic and tactical dynamics associated with real military operations. Besides learning about the force, space and time relationships in the specific battle or campaign being simulated, players soon acquire an intuitive feel for more generic interactive dynamics associated with warfare as a whole. Defence is usually stronger than attack, but an unduly passive defence risks having the enemy concentrate his assault on just part of the force and defeat it in detail (as in the Yom Kippur war, when Israel's counteroffensive against Syria prompted the Egyptians to leave the security of their defensive missile umbrella and resume the attack themselves).[1] Terrain may make certain sectors of the front more secure, but not if players choose to garrison them too thinly (as in the Ardennes in 1940 and 1944). As variation in combat outcomes during the game creates unexpected threats and opportunities, players will be faced with other classic real world dilemmas such as whether to reinforce success or salvage failure. Actually grappling with such dilemmas at first hand rather than simply reading or hearing about them has enormous educational potential, and the greatest benefit of recreational wargaming over the past 50 years is that it has given many hundreds of thousands of enthusiasts a level of understanding and detailed knowledge of warfare and military history that often eludes non-wargamers even after intensive formal studies.[2]

As I mentioned in the Introduction, military professionals have been benefiting from this educational function of wargaming ever since General von Muffling saw the potential of von Reisswitz's *Kriegsspiel* nearly two centuries ago. A key issue from the outset was whether it was better to codify the game system within comprehensive rules and charts or to base the modelling of

movement and combat on the wisdom and experience of an umpire. The latter approach, which became known as ‘free’ *Kriegsspiel*, had the advantage of simplicity and flexibility because there were fewer artificial constraints on what the antagonists could seek to do, but it depended absolutely on having a respected, knowledgeable and unbiased umpire, and meant that even the most mundane orders had to be enacted according to the one-off judgement of this God-like figure. The tables and charts of ‘rigid’ *Kriegsspiel* helped reduce the arbitrariness of umpiring and allowed less expert and eminent officers to run games, so most military gaming evolved towards a blend of the two extremes.[3] This hybrid approach is well illustrated by the official *Rules for the Conduct of the War-Game* published by the British Army in 1884, and I will now briefly summarise this publication to give a sense of how nineteenth-century military wargaming worked.[4]

The 33-page pamphlet outlined the need for several officers to provide the umpire and assistant umpires and to command the Red and Blue forces, including subordinate detachments. It called for the devising of a ‘general idea’ of the scenario to be played, together with ‘special ideas’ for each side on the basis of which they would decide their initial deployments (at least ten miles apart) and their initial orders. The game was played on a coloured Ordnance Survey map of the area around Dorking, at a scale of six inches to a mile. Metal blocks scaled to reflect the space occupied by units of infantry, cavalry, artillery and engineers were placed on the umpire’s master map, with each side fielding up to an entire army corps. The Red and Blue teams were confined to separate rooms with their own identical maps, on which were placed their own units and indications of enemy units that had come into view. A clock face was used to display ‘game time’, and was moved forward by anything between one minute and one hour or more at a time, depending on the umpire’s judgement of how soon events requiring new player orders would occur.

The pamphlet provided numerous charts to guide the umpire in determining such matters as march rates, the length of march columns, and the time taken for engineering tasks. Particular attention was paid to the modelling of combat among the various arms, with detailed provisions for the impact of numbers, terrain and unit formation and orientation, and for the duration and

bloodiness of firefights between opposing troops at different ranges. The umpire was advised to use die rolls to determine doubtful aspects where his own judgement did not suggest a clear outcome, and die rolls were integrated into the charts and tables to provide for random variation. An example was given of five battalions attacking three enemy ones, with a partial flank attack giving a further 3:2 advantage to the attackers, but with cover giving a 4:1 bonus to the defence. Multiplying these ratios together yielded overall odds of 24:15 or roughly 3:2 in favour of the defenders, and so there would be three chances in six of the defenders prevailing, two in six of the attackers prevailing, and one in six of a stalemate.[5] Similar principles were used to cover other aspects, with the rules laying down, for instance, that infantry had a 2:1 chance of preventing hostile guns from coming into action at 400 yards range, falling to even odds at 600 yards.[6] However, in the pamphlet's words: 'It cannot be too clearly understood that it is not necessary that a Player should have any previous knowledge of the Rules for Umpires, methods of using the tables, &c.; all that is necessary is that he should know his duty as a leader of troops according to the position he holds in the game.'[7]

The use of this kind of wargame for military training and education has continued to the present day. The rules and scenarios have evolved to reflect the changing face of warfare, but the basic principle of an imaginary conflict based on current military capabilities being fought out by two teams of officers in separate rooms under the direction of a team of umpires in a central room has remained intact.[8] Staff college courses now routinely include at least one such wargame, often lasting several days. I have observed or participated in a few such wargames at staff colleges or higher headquarters in recent years, although security restrictions prevent my discussing them further here. As warfare and military capabilities have become less symmetrical over time, so the educational focus has shifted more to the command of the friendly 'Blue' forces, with the opposing 'Red' forces often being handled by a smaller group of officers or directing staff.[9] The main technical change has been the integration of networked computer systems, with planning done online, and with movement and combat being calculated by the

computer program, although the umpires retain the flexibility to throw in complications of their own, especially today when conflict has become much more politically focused and much less a matter of a conventional duel between contending armed forces. Military wargames now often involve international links, with the software perhaps being brought and run by visiting experts from the USA, or with the same game being played in more than one country across a computer network.

Navies have been particularly keen on using wargames as an educational device, and as Perla's book shows, the US Naval War College has been very much in the vanguard.[10] Over 300 games were played at the College during the interwar period, more than 120 of them strategic games based on a possible war with Japan, and Perla wrote that: 'From an initial focus on a Mahanian vision of an early, decisive clash of the battle fleets, which would decide the outcome of the war in an afternoon, the games evolved into a more realistic and grimmer vision of a prolonged struggle, not just between fleets, but between nations and societies.'[11] From 1958 onwards, progressively more capable computer suites replaced the College's previous system of chart manoeuvres, although (as I discussed in Chapter 2) this computerisation proved to have costs as well as benefits, and Perla reported that: '[T]he War Gaming Department finds itself conducting more and more seminar-style games to avoid the strictures imposed by the rigid structure of the computerized system.'[12] However, the perceived utility of gaming remained high, and Professor Robert Rubel, who chaired the War Gaming Department at the College, wrote in 2006 that: 'War gaming is a distinct and historically significant tool that warriors have used over the centuries to help them understand war in general and the nature of specific upcoming operations.'[13]

The relationship between military and recreational wargaming over the past 50 years has been decidedly double-edged. On the one hand, professional wargamers, already sensitive to the negative connotations of the word 'game', have often been embarrassed by any link with hobbyists, especially given the blurred boundaries between recreational wargaming and playing with toy soldiers or the popular enthusiasm for fantasy gaming. As Allen reported: '"This is not Dungeons and Dragons we're doing

here," a Pentagon officer indignantly told me in a discussion of what he called "serious modeling and simulation".'[14] On the other hand, many professional wargamers themselves play recreational wargames in their spare time (Dunnigan reported that around 20 per cent of hobbyists were in the military or related government jobs), and dissatisfaction with the cost and unwieldiness of official games has often prompted officers to investigate cheaper and more accessible commercial alternatives.[15] Dunnigan himself has been an enthusiastic advocate of this approach, although he claims that: '[T]he existing government suppliers of wargame technology did what they could to discourage the purchase of these "toys" (commercial wargames), as the "toys" were a lot cheaper and more competitive than the mutimillion-dollar military wargame projects that kept so many defense consultants (and many government employees) comfortably employed.'[16]

There have been periodic meetings bringing together professional and recreational wargame designers, especially the annual 'Connections' conference organised by USAF Colonel Matt Caffrey since 1993, and held until recently at the Air War College in Alabama. Boardgame designers such as Mark Herman, Joe Balkoski, David Isby, John Prados and James Dunnigan himself have often carried out consultancy work for military clients.[17] Colonel Ray Macedonia, head of wargaming at the US Army War College, admitted in 1989 that the Army's McClintic model borrowed heavily from Dunnigan's 1973 hobby game *NATO* on a possible European war, and he went on to say that: 'So much of what we do … is extrapolate lessons of war and learn from history, and there's no better tool for doing that than some of the commercial war games. Some of the best history lessons for officers anywhere are contained in the same games you can buy in a hobby store for $40.'[18]

A few tactical boardgames were designed for both professional and recreational use, including Dunnigan's 1976 game *Firefight* which began as a US Army project, and USAF Major Gary Morgan's games *Flight Leader* (1986) and *Tac Air* (1988), which were originally produced for officer education as part of the Air Force's 'Project Warrior'.[19] Phil Barker's insightful figure game rules on modern combat spawned military training versions for the

US and Canadian armies during the final years of the Cold War, and his new *Sharp End* rules for counterinsurgency warfare in theatres like Iraq and Afghanistan are a by-product of consultancy work for the UK Ministry of Defence.[20] There has been (and continues to be) some use of these and other manual games for military training, usually led by personnel who are themselves recreational wargamers and who appreciate the compact and down-to-earth nature of commercial games compared to the more cumbersome and 'politically correct' official products.[21] However, there is little evidence of non-wargamers taking up such manual games, due to the usual concerns over their complexity and lack of realism.[22] As US Marine Captain Eric Walters put it: '[E]ven these relatively simple games are just too complicated for the majority of people. No doubt also that the image of spending hours bent over "a kid's game" cannot be compared with the commonly perceived training value of "going out and getting your boots muddy".'[23]

The real revolution in military use of commercial wargames has come over the past two decades, with growing crossover in the field of real time 3D computer simulators. Far more recruits are now familiar with such first-person shooter games than ever played manual wargames in the past, and working with 'commercial off-the-shelf' products brings big savings for the military compared to developing their own tactical simulators from scratch.[24] Whereas the manual game *Dungeons and Dragons* had previously been anathema, the even more lurid computer fantasy game *Doom* was adapted in 1997 into the US training aid *Marine Doom*. The US Army went one better, and in 2003 it famously gave away its own video game *America's Army* (based on another fantasy shooter, *Unreal*) as a free recruitment device.[25] Commercial combat simulators such as *Full Spectrum Warrior* and *Close Combat: First to Fight* were marketed as being based on real military training aids, while *Armed Assault*, a development of the 'ultra-realistic' and highly adaptable commercial game *Operation Flashpoint*, was soon adopted for military use as *VBS2* within networked multiplayer facilities.[26] This simulation proved its cost effectiveness and training value in a growing range of contexts by allowing every soldier in a platoon to practise coordinated responses with his or her personal avatar to astonishingly lifelike virtual challenges like

those being faced for real in Iraq and Afghanistan, and in 2009 its use came full circle when it was given out free by the British Army as a recruitment tool.[27]

Efforts to bring together military and recreational wargaming have stemmed in large part from those many defence professionals (such as Perla, Caffrey and Morgan) who have also happened to be hobbyists.[28] This is not surprising, since General von Muffling declared at the outset that civilian wargame designs 'have never seriously been able to claim the attention of trained officers' and that only the input of von Reisswitz's officer son made his *Kriegsspiel* worthy of notice.[29] Such prejudices softened somewhat with the rise of civilian operational researchers and systems analysts, allowing outsiders like Dunnigan and Barker (themselves once soldiers) to have an impact on military gaming. However, it was only really technical change in the form of mass market computer gaming that prompted a thorough convergence of military and hobby activities, at least at the tactical level. At the operational and strategic levels, beyond the vivid immediacy of 3D virtualisation, military and hobby wargames remain as loosely connected as ever.

The biggest obstacle to greater integration of professional and recreational wargaming is the fact that they have different priorities. Most hobby games are focused on reconstructing past campaigns, whereas officers and defence experts are concerned mainly with gaming current and potential future conflicts. Professionals use umpired multiplayer games, furthermore, to mirror the experience and uncertainties of real military command, whereas traditional hobbyists tend to prefer bilateral or solitaire exploration of complex 'working models' of actual conflicts, from a much more 'God-like' perspective.[30] It is this difference in preferences, rather than any variation in the 'seriousness' of the two approaches, which limits the scope for direct collaboration, although it also, of course, means that the two groups are potentially highly complementary, and between them contribute a great deal to modelling and understanding warfare as a whole.[31]

So where does my own educational employment of wargames during my 25 years as a war studies academic fit into this overall pattern? The story is essentially one of constant experimentation

and incremental growth, starting small and then building on whatever worked until wargaming became a crucial element within my overall teaching technique. Although I have made significant use of ‘off the shelf’ commercial products, the dominant element throughout has been the design of new, tailored games to give the best possible balance of accuracy and simplicity, as I discussed in Chapter 2. Part III is full of detailed examples of how I have used wargames to help teach specific topics within war studies, but I will lay the groundwork here by covering more generic and crosscutting issues.

Wargames are, of course, an advanced form of ‘active learning’, as opposed to the passive absorption of information transmitted by the teacher. Lectures do have the great advantage that they allow rapid delivery of precisely tailored information and interpretations to large audiences, and having lectured regularly to audiences of 400 officers at staff college, I know that they have their place. However, having sat in the audience myself for many lectures and conference presentations, I also know that this teaching method has enormous weaknesses. Unlike with books, listeners cannot vary the pace to focus on quickly finding and then studying at leisure the material really desired, and especially if there are no visual aids or note taking to help structure memories, it is frightening how little one can actually recall after it has vanished into the ether. Lectures are nevertheless popular with hard-pressed students, since they do not require preparatory work on their part, and they seem to offer an efficient *précis* of information and ideas that can be parroted back at the teacher in the final exam. However, to reduce a module equating to nearly three months of full-time study into the learning and repetition of a few dozen hours of lecture material seems to me the very antithesis of education.

Fortunately, my experience of staff college teaching and my observation of some of our BA students during their extra-curricular activities with service units such as the Officer Training Corps have left me in no doubt that students at all levels are capable of far more than just passive absorption of my own ideas. Hence, I use not only traditional seminar discussions to allow them to participate in the education process; I also routinely employ individual and team presentations and debates, to get the students

to research and think about the issues for themselves. There are few better spurs to reading and thought than the prospect of having to give a talk on a subject, so the more actively the students participate in this way, the more they really learn. Working in teams builds cooperative skills that are invaluable for future employment, and it is also an excellent way of offsetting individual nervousness or other presentation problems.

Debates work very well indeed, because their inherently agonistic character spurs students to research topics even more deeply in order to prevail, and because they dispel the idea that there is only one 'correct' view on controversial topics.[32] Wargames have similar educational advantages for the study of war, because students must grapple with real strategic and tactical dilemmas as they struggle to beat their colleagues, and because the games show that the historical outcome of a conflict was not bound to occur. As Overy put it:

> I think above all the hallmark of a good historian is historical imagination: to be able to put yourself back in the period in which you are interested and make that imaginative leap, not to share the assumptions that surround you in the contemporary world but to imagine that the rest of history has not yet happened … It is very important to recognize that people do not know what is going to happen – the expectations or ambitions might be very different from reality – or indeed history might for one reason or another take a sudden shock turn.[33]

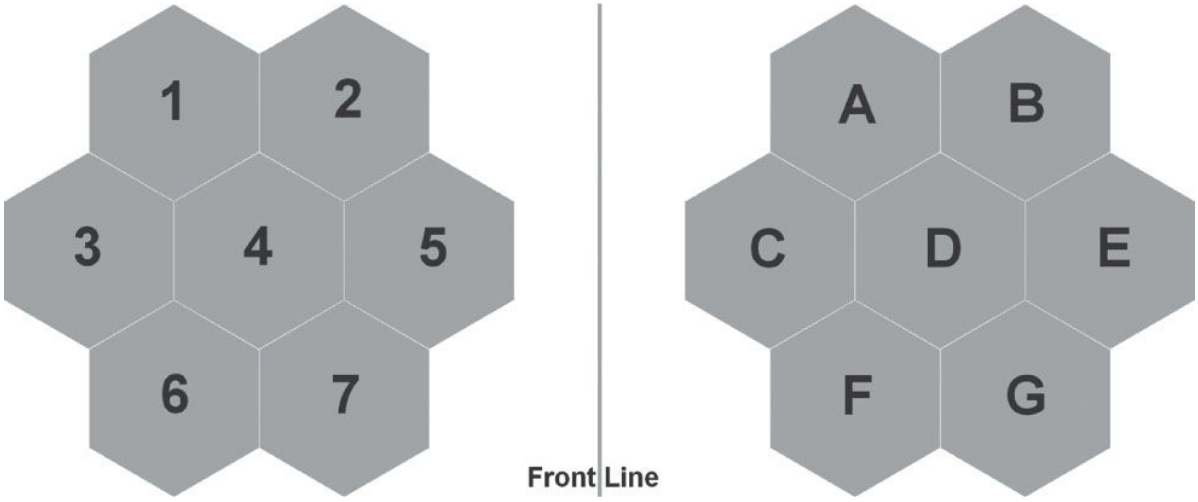
As with any teaching method, the first priority when deciding to employ a wargame in class is to have a clear sense of the educational objective. During the 1990s, I spent a lot of time visiting the RAF Staff College and then the new Joint Services Command and Staff College, running the MA in defence studies, which I designed as an upgrade to the existing one-year advanced command and staff course, and later helping to establish King's College London's contractual partnership with the College, which now involves the permanent deployment there of over 50 academic staff. My own teaching contribution focused on the interactive dynamics of strategy, and I wanted to illustrate these

dynamics to the officers at once rather than leaving this to the usual big military-run wargame at the end of the course. Hence, I designed several short abstract games that I used in successive years to back up my strategy lectures.

The first game, which I used with a class of about 20 Air Force officers, focused on a generic *Bomber Offensive* like those in World War Two. The students were divided into pairs, with one playing the attacker and the other the defender, before swapping sides. There were three generic target sets, which all started out with the maximum 20 points of resilience, but which differed in the rate at which they recovered from damage – one regained 3 points per turn, another 2 points, and the third just 1 point (perhaps corresponding to a vulnerable target system such as oil). The games were played in turns, each of which started out with the defender secretly redistributing 10 air defence points among the three target sets (giving at least two to each). The attacker then announced whether or not he was launching his bombers (initially 6 points worth) on raids, and if so against which one target set. If raids were launched that turn, as many points of bombers were shot down as there were air defence points around that target, and then the target set lost as many points of resilience as there were surviving bombers. Finally, all targets regained resilience at the appropriate rate, the surviving bomber fleet was increased by 2 points (to a maximum of 10), and play continued with the next turn. The attacker won as soon as any target set lost all its resilience, and the object was to achieve this in as few turns as possible. Despite its speed and simplicity, the game vividly illustrated the attritional nature of the bomber campaign, the profound importance of time in the race between destruction and reconstruction, the problems of simply focusing on the most vulnerable target set in the face of concentrated defences, and the contest of bluff and double bluff over which target set to attack at any given time.[34] Even after each pair of officers had played the game twice, there was still plenty of time to explore these points and to broaden out into a more general seminar discussion of strategic dynamics.

Once the staff colleges merged and I began to teach all 400 officers, I devised a new, less service-specific game to make similar strategic points, while remaining simple enough that it could be run by each of my three dozen academic colleagues in the

‘breakout sessions’ after my plenary lecture. In this game, entitled *Gotcha!*, students were again divided into pairs, but each had a single unit that they deployed secretly in one of the seven hexes on their own side of the front line, as shown in Figure 3.1 (note that the two hex grids represent entirely separate areas). The single unit on each side could be thought of as representing an artillery battery, an aircraft carrier battlegroup, or an air wing shifting between different bases, according to service taste! The game was again played in turns, during each of which the players chose secretly and simultaneously whether to do nothing, move their unit to an adjacent hex, reconnoitre enemy territory to discover which hex the enemy unit occupied or was moving to, or attack a specific enemy hex. The winner was the player who first attacked the hex that the enemy unit occupied at the end of that turn – if both units hit simultaneously, there was mutual suppression and the game continued.



3.1 Playing surface for *Gotcha!*

This abstract game was little more complex than *Battleships*, but it did pose difficult and quite realistic choices between the priority accorded to reconnaissance, offensive action, and evasion once observed.[35] The game again demonstrated the strategic mechanics of bluff and double-bluff and the weaknesses of the most ‘efficient’ approach in a context of limited information – occupying the centre hex gave the most routes of escape if detected, but it was also so obvious that it might invite a speculative attack in the hope of an immediate triumph. Similarly,

doing nothing with an observed unit might be seen as a dangerous waste of a turn, but not if the opponent was misled into thinking that the unit must surely have used the turn to move to one of the adjacent hexes. The game was quick enough to allow the pairs of officers to play over and over again until the tutor called a common halt – always an advantage, since otherwise some students are left twiddling their thumbs while waiting for other games to conclude.

My most ambitious staff college game before I left the teaching there entirely to my resident colleagues was designed to follow my lecture on Clausewitz. I decided that it would be appropriate to illustrate his strategic theories by modelling a generic battle in his own Napoleonic era, and moreover to do so using the very thing which he said war most resembled – a game of cards. The resulting game, *Kartenspiel*, is too involved to summarise completely here, but I have included the full instructions in Appendix 5, together with the supplementary notes that I gave to my colleagues and to the military directing staff to help them run the game in their syndicates and to lead the subsequent discussion. Unlike the previous two games, this one divided the ten students in each syndicate into two teams of five, with each person having their own individual role but working together to try to defeat the other team. This had the advantages that it encouraged discussion and debate during the game as well as afterwards, and that it left foreign students with shaky English less isolated. In retrospect, it was perhaps a little too ambitious and *dirigiste* to expect all of my non-wargaming colleagues to run this game smoothly on their own, even though we did as before discuss it in detail in advance during a lengthy staff 'clinic' session. However, the game worked perfectly well, and it still offers a simple way of bringing home to students at all levels the dynamic and interactive nature of warfare, the impact of uncertainty, and the dilemmas raised by conflicting military principles.[36]

Over the past decade, I have focused much more on teaching civilian students at King's College London itself. In Part III, I discuss my use of wargames to support my BA courses in various aspects of military history. Since I now teach entire modules and do not have to rely on colleagues to run games for hundreds of students, I am able to employ more sophisticated simulations of specific historical conflicts, some of them lasting for most of a

single two-hour class. As I will show, these longer games are popular and valuable, and give the students practical insights into battle or campaign dynamics that they would never have gained from simply reading or hearing about the engagements concerned. However, just as the best way of learning about a subject is to have to give a presentation on it oneself, so the greatest insight to be gained from conflict simulations comes from designing them rather than merely playing them. McCarty wrote that: 'Simulation, like game-playing, tends to forgetfulness of the mechanism by which it is created, so long as its terms of engagement (expressed in parameters and algorithms) are fixed. Unfix them … and the simulation becomes a modeling exercise … Thus simulation crosses over into modeling when the constants of the system become variables.'[37] To achieve this ideal, I decided to develop a new MA option module that would focus entirely on studying conflict simulation techniques, and in which students would 'cross over into modelling' by designing their own microgames on a historical conflict of their choice.

The proposal aroused some initial scepticism due to the kind of misperceptions about wargaming that I discussed in Chapter 1, but I was easily able to dispel these by showing my colleagues how serious and well researched many published wargames really are. Joe Balkoski's detailed simulation of the fighting around *St-Lô* in July 1944 proved particularly helpful in this regard.[38] A greater problem was logistics, since the College library predictably considered it impractical to acquire and stock such boardgames for student reference, because of their separate maps and counters. However, we agreed an alternative solution within which I would build up my own personal collection of wargames even further with the help of a small annual contribution from departmental funds, so that I could lend each student around half a dozen games that were most appropriate to their own chosen topic. I do not lend the counters, since these are so susceptible to loss, but the online availability of digitised *Cyberboard* versions of many games helps to overcome this limitation (as I will discuss in Appendix 4). I take careful note of exactly what game components I do lend to each student, since it is all too easy for some to get misplaced, but this system has worked well overall, and it maximises the utility of the wargame collection which I have amassed at such effort and cost.

The educational utility of the module is best summarised within its aims and objectives. The aims of the course are as follows:

- to familiarise students with the various possible mechanisms of conflict simulation, and the strengths and weaknesses of each
- to allow students to create their own original simulation of a particular historical campaign or battle of their choice
- to use simulation and modelling to encourage students to analyse the key dynamics of conflict situations, thereby gaining greater insight into the physical and human determinants of conflict
- to help develop a wide range of skills, including critical appraisal of existing simulations, detailed historical research into a specific campaign, intellectual creativity in devising and testing simulation models, legalistic clarity and precision in drafting simulation rules, and design skills in producing simulation graphics
- to allow students to practise broader transferable skills, in particular team work in a variety of contacts, familiarity with handling computer graphics, and the use of the internet to find information and disseminate ideas.

After successfully completing the course, students should be able to do the following:

- understand the various mechanisms through which conflict simulation games may operate
- appreciate the artificialities in conflict simulation games, and the inevitable tension between ‘realism’ and ‘playability’
- discuss the utility and the limitations of conflict simulation games in helping to understand conflict dynamics
- critically assess existing conflict simulation games, and suggest possible improvements
- produce to a satisfactory standard their own small conflict simulation game, through all the stages from detailed historical research through concept development, rules drafting, graphic design and rigorous play-testing to the physical production of a finished game with rules, map and counters

- reflect critically on the design choices made and the strengths and limitations of their game, in extensive designer's notes.

The module first ran in 2003 and has continued ever since. It usually attracts six to twelve students a year, which is an ideal number since the teaching and assessment effort I need to invest per person is significantly greater than for traditional courses. Some students have played board wargames before, others have played only computer games, and around half of each intake have no prior experience with wargames at all. After an initial culture shock, it is sometimes the last group that produces the best designs, partly because it is less fixated on the conventions and complexity associated with existing published games. (This suggests that Dunnigan is being a little pessimistic when he says that: 'Probably no more than a few percent of the population can grasp the internal concepts of wargames.')[39] I group the students into teams of three or four people working on related topics, so that they may comment on and playtest one another's designs. As I discussed in Chapter 2, focusing on board wargames rather than computer games is absolutely essential, since hardly any of the students in war studies have the programming skills needed to create even basic PC games. However, the students do make impressive use of computer graphics software and exchange digital drafts of their designs with me and with one another as their work proceeds. Many of them agree to have their final designs (with digital versions of the maps and counters) posted on the open access course website, and this now hosts over 40 past student projects covering battles and campaigns from Alexander's victory at Arbela in 331bc to the Lebanon war in 2006.[40]

I impose similar physical limits on the projects as those in the SPI 'quad' games of the 1970s, namely a maximum of 100 counters, a 17" x 22" map, and 7500 words of rules and examples of play.[41] After the first year of the course, I realised that there needed to be an additional constraint, namely that it must be possible for inexperienced players to set up and complete the game within 150 minutes at most. This constraint often proves the hardest for students to meet, but it is vital so as to make playtests and assessment viable. I rule out games needing more than two

players for similar practical reasons, and I insist that the projects must simulate specific historical rather than generic or hypothetical engagements, so that it is possible to gauge how closely they parallel the observed reality. The students are also required to include a historical analysis of the real conflict, designer's notes on the simulation decisions they have taken, and a reflective essay on what this unusual approach to the study of war has taught them. These extra essays together add up to at least as many words as the rules themselves, and they are of particular assistance to internal and external examiners who are less familiar with wargame techniques. Far from being fazed by the simulation projects, examiners have found them very worthwhile and enjoyable – one external praised the course for providing 'fascinating assessment and a welcome change to the usual chore of essays'.[42]

The reflective essays give useful insights into the educational value of the course to the students themselves, as illustrated by these statements from the last student cohort. One person wrote that: 'Rather than simply learning about what happened, I started to better understand the give-and-take *dynamics* of what happened. The key lesson learned in developing this simulation was learning about balance.' Another student said that: 'Working on this project reinforced the critical importance of *incentive analysis*. Understanding what are the rewards and penalties the actor faces was a critical element in designing the simulation, and I believe that it is a critical element in any conflict assessment and analysis.' For a third student: 'Something that did become apparent during the design process, and that I will try to always remember because it inadvertently models life, is the surprising ways that seemingly unrelated things can interact, function and change things over time.' Finally, one person wrote that: 'Unlike other courses, where you dip in and out of the subject matter, in the conflict simulation I found myself continuously thinking about how to improve my simulation. Overall I have found this course one of the best in both my undergraduate and postgraduate career.'

The course as a whole covers essentially the same range of topics as I discuss in this book (including the ethical dimension of wargaming, which I explore in Chapter 10). Particular emphasis is placed on the research and design issues, which I cover in

Chapters 4 to 8. We routinely have guest sessions with professional military and Ministry of Defence wargamers and with prominent recreational wargame designers such as Charles Vasey, Paul Rohrbaugh and Richard Berg. Former students (several of whom have gone on to do PhDs in the department) also return year after year to help and advise their successors. The course programme has evolved significantly over time in response to student suggestions and feedback, and the biggest problem is squeezing all the many possible activities into the time available. Students usually get caught up in their projects so they devote significantly more time to them than they would with traditional essays, and this effort is reflected in the above average marks which the projects usually receive. Two student designs, Andrew Mulholland's *Assault on Narvik* and Arrigo Velicogna's *An Loc*, have been published in the commercial wargames journal *Against the Odds*, which is unusual for MA-level work and confirms the high standard that the projects often attain.[43]

Whereas many academics experience sharp 'zero-sum' tensions between the time they devote to teaching and research (due to the limited overlap between generalist and specialist activities), I have found wargaming to offer tremendous synergies, especially now that I run an MA course on conflict simulation itself. As I will discuss in Chapter 4, my previous book, *Lost Battles*, uses wargaming techniques to provide highly innovative research insights into the land battles of the ancient world, but it also allows me to bring these engagements to life for my BA students in a far more realistic (albeit less graphically vivid) fashion than in the mass market PC game *Rome: Total War*, and it gives my MA students a very detailed practical example of how a conflict simulation may be constructed.[44] The present book similarly provides both a research study of an otherwise highly inaccessible and little known corpus of recreational wargaming literature, and a practical handbook on the art and science of simulation design. I use the same wargames described in Part III to teach BA students about the particular conflicts concerned and to teach my MA students how simulations work and how they may produce their own. Even deeper synergies have now developed, since some past MA student projects from the course website now appear on the reading lists for my BA courses, and Garrett Mills's design from

2007 even forms the basis of an entire BA class, as I will discuss in Chapter 9.

One further synergy between my BA and MA teaching has proved invaluable in tackling what was otherwise becoming a serious limitation in my use of wargames as an educational device. Although ultra-simple games such as *Bomber Offensive* and *Gotcha!*, described earlier, were able to be played by multiple pairs of students without individual oversight, the furthest I was able to take this principle was the mass playing by around 50 postgraduates of a ruthlessly simplified version of my already very basic ancient battle game *Phalanx*, with just ten units per side.[45] Anything more complex required too much precious time to be spent at the start of the session explaining every detail of the rules, and some non-wargamers still took far too long to play the games, as I mentioned in Chapter 2. Hence, I moved to the alternative approach of running just one big game myself, with all the students observing and contributing command decisions. This allowed me to move the game along more swiftly, and meant that I needed only to give a broad summary of the rules to the players, who could concentrate (as in military *Kriegsspiel*) more on real strategic and tactical considerations to guide their actions. The single-game approach worked well with classes of up to ten students, since they could usually be given different parts of the forces to command, and since the resulting discussions within teams over what to do served a useful educational purpose. However, in larger classes, having just one game meant that some students inevitably became disengaged, since there was no scope for them all to make meaningful decision inputs.

This is where my MA teaching on conflict simulation came to the rescue. In 2009, I started to use current and former MA students from my conflict simulation option as teaching assistants to run games in my BA classes. This allowed me either to have two games running simultaneously (one led by me and the other by a teaching assistant) or three games being played at once (all run by teaching assistants, with me on hand to consult and intervene as required). Not only did this benefit the BA students by doubling or trebling their direct involvement (allowing me to use games effectively in classes of up to 30 students), but it also helped the postgraduate teaching assistants, since it supplemented their

funds slightly, gave them valuable teaching experience and, above all, forced them to gain a real understanding of how simulations work (in line with my general belief that the best way to learn about something is to have to lead a session on it oneself). In all these ways, my educational use of simulation games evolved into an interconnected and synergistic endeavour.

As I mentioned in Chapter 1, employment of simulations and games for teaching purposes has now become common across a variety of subjects and at all levels from schools to universities, and there is a lot of theoretical and research literature about the pros and contras of this approach and the best way to obtain the desired results.[46] In my experience, the single most important element is that teachers should be bold enough and flexible enough to seek to inspire students using whatever approaches they themselves have found most interesting and inspirational, rather than sticking to conventional educational techniques just because they are easy and uncontroversial. As I will discuss in Chapter 4, my own first instinct when trying to come to grips with a conflict is to try to construct a dynamic model to capture the essentials of what is going on. This analytical approach underlies all of my writing and lectures in the war studies field, and so extending it by getting the students to play or design simulation games based on similar dynamic models is an entirely natural progression, and a perfect complement to my other teaching techniques. Using manual wargames is now very unusual in both military and civilian education, and so there is a lot of scepticism and misunderstanding to overcome when one tries to do so. The novelty of the approach, however, does at least attract a certain notoriety – my talk on the subject to the Higher Education Academy in 2008 has just been published in the *Journal of Strategic Studies* in Japan, and in 2009 I won an 'Innovative Teacher Award' at King's College London for my endeavours.[47] I hope that my own experiences as reflected in this book will give other teachers the courage and inspiration to try such educational techniques in areas where they themselves find simulation modelling a useful way of understanding the topics concerned.

4

Simulation research

What makes both professional and recreational wargames ‘serious’ and not mere abstract diversions is that they attempt to simulate certain key aspects of real armed conflicts. Research is thus an integral and indispensable element of wargame design. The research involved is not very different in character from that required to write an article or book on the real or potential conflict concerned (and some designers do indeed write such works), but simulation research does have two important distinguishing features.[1] First, it has a rather different focus than the research that underpins conventional written studies – it tends to be encyclopaedic and explanatory rather than anecdotal and descriptive, and to cover aspects that other researchers often neglect. Second, the relationship between research and simulation design is much more iterative and bidirectional than in traditional academic writing, since the design and playing of wargames offers new insights and raises new research questions rather than just reporting what the researcher has discovered. In this chapter, I will first explore the unique challenges of the research needed to underpin simulation games, and then I will discuss the contribution of such simulations as research tools in their own right.

As I explained in Chapter 1, wargames focus far more on the underlying dynamics of a conflict than on the narrative details. Whereas some writers are content simply to ‘tell the story’ of a past conflict without too much effort to explain exactly why it developed as it did, for wargames, the explanation is all – playing the game generates its own different narrative every time, even for hypothetical past or future campaigns that have not actually happened. Wargame research needs to cover four main areas in order to underpin this dynamic model of reality. First, designers need to understand the **geographic environment**, including physical terrain, manmade infrastructure, and all the human, industrial and natural resources that could potentially shape the course of the conflict. Second, researchers must assess the **orders of battle** of the opposing forces, including their size, equipment, quality, initial deployment, and what factors affect

subsequent reinforcement or denuding of the contending sides. Third, designers need to investigate the **generic capabilities** of these kinds of force, including their ability to move, their supply needs, and what variables determine the course and outcome of combat when particular force elements clash. Last but by no means least researchers must explore the **decision environment** facing the real commanders, including such aspects as intelligence, the fog of war, command and control capabilities, and the influence of political considerations and strategic culture.[2] I will discuss the challenge of researching each of these four areas shortly, but first I will identify the four general categories of research source on which wargame designers may draw.[3]

For conflicts that have actually occurred (however recently), **historical** sources are usually the most important, since they describe and analyse what happened in actuality. This category includes a wide range of primary and secondary material, from unit records, war diaries and memoirs to newspaper reports, popular accounts and academic histories of the battle or campaign concerned. The volume of available evidence is far greater for modern wars, especially those in which western nations have been involved, given the growing pervasiveness of film and video imagery and given the increasing tendency for individuals from private soldiers to political leaders to talk and write prolifically about their personal experience of the conflict.[4] However, this is offset for recent wars by the continuing classification of official records and by the tendency for one or both antagonists to focus more on propaganda than on objective analysis. The Second World War still offers the best balance between the availability of individual testimony and of declassified records from both sides, and it is no coincidence that the majority of published wargames focus on some aspect of this massive conflict.

Historical sources have two major limitations from a simulation design perspective. First, one soon discovers that their reliability on the kind of specific details needed for wargame design is shaky to say the least. As I illustrate further later, they are often riddled with factual errors and disagreements, as Parshall and Tully make remorselessly clear when they identify nine pervasive myths in previous historiography concerning the Battle of Midway.[5] Second, historical sources (especially secondary ones) naturally tend to focus much more on the factors and events which made a crucial difference in reality than on giving a more balanced overview of what *might* have

mattered had the battle taken a different course. Hence, for example, it is easy to find information in history books about the Stalingrad campaign, the Salerno landings or the fighting in the Normandy *bocage*, but harder to glean similar details of the terrain and troop deployments associated with other actual or potential battle areas such as the Vyazma salient, Sardinia or Brittany.[6] This entirely understandable tendency of historical sources to be anecdotal and descriptive rather than encyclopaedic means that they must be supplemented by other evidence for the purposes of simulation design. Counterfactual studies like those which I discussed in Chapter 1 help to some extent, but even they tend to pursue specific alternate strands rather than providing the generic background data that wargame designers really need.[7]

A second key category of evidence is **technical** source material. This includes atlases, statistical digests, equipment performance data, and details of the generic organisation and tactical doctrine of the opposing forces (whether for historical or potential future conflicts).[8] John Ellis's *Databooks* on the two world wars give a useful overview of the various kinds of evidence involved, since they bring together campaign maps, orders of battle, tables of organisation and equipment, figures for force strength, losses and production, and hardware performance data.[9] Historical atlases are especially useful for simulation designers, since they give vital spatial information and tend to be less focused on just the most famous parts of each campaign.[10] There are many thousands of more detailed studies of particular national units or services or of specific types of military equipment, usually produced by enthusiasts who find such 'nuts and bolts' treatments compelling.[11] For instance, my own library includes four books on the US P-51 Mustang fighter plane, not to mention the dozens of more general aviation works in which the type features.[12] The data such sources contain can be very useful in supplementing the more impressionistic, selective details found in historical accounts, but it is important that simulation designers not become too fixated on the technicalities concerned. Statistics are notoriously difficult to interpret in isolation, there may be large gaps between theory and practice in areas such as equipment performance and unit strength, and (as I pointed out when discussing computer games in Chapter 2) human factors tend to have a decisive impact in real conflicts, despite being very hard to quantify.

A third broad category of sources is **comparative** evidence, which uses experience from other engagements to cast additional light on the particular battle or campaign being simulated. These other engagements are usually drawn from the same era (and if possible the same war) so as to minimise differences that would make the comparison invalid. There are now numerous comparative studies that seek to develop general theories about the mechanics of battle in eras such as classical Greece, the Punic wars, the Napoleonic era or the US Civil War, based on evidence drawn from the many individual clashes that took place during these periods.[13] As I will show in Chapter 11, tactical wargames often focus purely on mirroring such generic battle dynamics, without attempting to simulate any single specific engagement. Sometimes much broader comparative methodologies are employed, for instance when trying to understand the ill-documented wars of antiquity by extrapolating backwards from much better known nineteenth-century conflicts, when land operations still depended on muscle power and human courage despite the impact of gunpowder on the battlefield itself.[14] Comparative evidence is obviously especially vital when trying to model hypothetical conflicts for which no direct historical sources exist – hence the preoccupation of analysts like Biddle, Dupuy and Rowland with using engagements in the recent past to develop theories that can be extrapolated forward to cast light on potential future clashes.[15] Although there is always a risk that differences will render the comparisons invalid, I do think that comparative evidence has a key role to play in simulation design, as I will show later in this chapter when I discuss my own use of such methodologies to cast new light on ancient battles.

The final generic category of source material consists of earlier **simulations** of the same conflict. Dunnigan boiled down his advice to would-be wargame designers to just two characteristically pithy precepts – ‘Keep it Simple’ and ‘Plagiarize’.[16] Since simulations all need to be based on the four component elements I identified at the start of this chapter, it is entirely understandable that designers should be tempted to use other wargames covering the same engagement as a research source, since it is so much easier to copy geographical and order of battle details from such simulations than to find the same information in history books and the like. However, relying on other wargames in this way can be at least as dangerous as relying on other secondary accounts, since it can perpetuate errors based on inadequate initial scholarship. Veteran designer Richard Berg tells a

story of how he could not get Dunnigan's 1976 draft game on the fighting around Smolensk in 1941 to follow the historical pattern of the fighting, until he realised that the draft map (based on Dunnigan's 1973 game on the battles in the same region in 1944) was dreadfully inaccurate in its portrayal of the real pattern of forests and rivers.[17] Just because a published game contains masses of finely detailed information does not mean that the information is reliable – it may represent little more than guesswork, especially if hard evidence from other sources is difficult to find.

This issue of the depth of research behind conflict simulations is crucial for any hope of academic credibility. Since published wargames are entirely commercial products intended for recreational rather than scholarly use, explicit footnotes and references to back up their reconstructions are very rare. Although some games do include select or full bibliographies of the primary and secondary sources consulted during their design (including interviews and foreign language documents, and running in one celebrated case to 224 separate listings over six pages), the majority of wargames contain no bibliographic information whatsoever, so as to maximise the space available for the rules.[18] Most such games are still based on extensive research, but a lot depends on the priorities and proclivities of the designers themselves. In 2009 I wrote a comparative review of several recent wargames and popular books on Alexander's victory at the Granicus in 334bc.[19] I showed that some of the games and books were full of inaccuracies and sheer inventions, but that others were much more scholarly in their approach, despite the constraints of the media concerned.[20] Since some wargame reviewers are not that knowledgeable themselves about the underlying history, and focus more on how the product works as a pure game, it is important for users more concerned with gaining historical insights to employ other types of sources for crosschecking so as to help gauge the rigour of different simulation designs.[21]

Published wargames on the battle in the city of Stalingrad in the autumn of 1942 offer an excellent case study of the variable attitudes of designers and players to historical accuracy. On the one hand, Tetsuya Nakamura's fairly simple 2008 game *Storm over Stalingrad* clearly prioritises game play over simulation, since it ignores the historical Soviet salient around Orlovka, and has the German assaults on the southern city and northern factory district occurring simultaneously rather than sequentially.[22] On the other hand, Dave

Parham, who undertook extensive archival research for the much more detailed 1980 games *Streets of Stalingrad* and *Battle for Stalingrad*, discovered that (contrary to Chuikov's claims in his memoir of the battle) the German 76th division did not actually take part in the city fighting at all.[23] Later wargame designers (including Nakamura) also benefited from this correction because they used these 1980 games as a research source, but more conventional historians unfamiliar with simulation gaming often repeated Chuikov's error, until Glantz discovered it independently during research in the German archives for his monumentally detailed 2009 book.[24] It is ironic that Antony Beevor should criticise Niall Ferguson's recent suggestions for educational employment of wargames by saying that: 'To be perfectly honest there's more than enough you need to learn about the basic structure before you start playing counterfactual', since, had Beevor himself looked at any of the published simulation games on Stalingrad while researching his own famous book on the battle in the late 1990s, he might not have claimed repeatedly that the German assault on the city centre in mid-September involved three infantry divisions rather than the actual two (71st and 295th).[25] At least in this regard, wargames on Stalingrad over the past 30 years have been more accurate than most history books.

The moral of this tale is twofold. First, historians should be much less dismissive of the value of examining relevant conflict simulations when studying and writing about a particular battle, even though they will undoubtedly find some that amply justify their initial scepticism. As I will illustrate again later, wargames have no monopoly on errors and distortions, and conventional works of military history (even by the most respected scholars) contain plenty of howlers of their own. Jesus's injunction to, 'Judge not, lest you be judged' is particularly apposite in this regard.[26] Second, as I discussed in Chapter 2, there is clearly a real tension between detailed but unplayable simulations like *Streets of Stalingrad*, aimed at impressing historical enthusiasts, and simple but inaccurate games such as *Storm over Stalingrad*, focused on giving an enjoyable game with only a patina of historical realism. The challenge is to blend the rigour of the former with the simplicity of the latter so as to obtain the best of both worlds. I now discuss the research needed to underpin such an approach, by considering the four component elements I identified at the start of the chapter.

How difficult it is to understand the **geographic environment** of a conflict depends enormously on the conflict concerned. For tactical air

and naval simulations, this element may be almost trivial because of the barren uniformity of the medium, while for grand strategic simulations, grasping the human, economic and physical geography of entire continents becomes the most difficult element of the entire design challenge. Map sources are key and the important thing is to consult as many different maps as possible. I know from personal experience as a writer and editor that the process by which maps are generated in military history books can be terrifyingly haphazard, opening the way to gross distortions of real spatial relationships. Editors and proof readers who easily spot the most minor grammatical glitches in the text of books often have a glaring blind spot over maps and statistics, as illustrated by the fact that the map scales in Glantz and House's 1995 book on the Eastern Front in World War Two and in Goldsworthy's 2001 book on the battle of Cannae are consistently out by 50 per cent and 100 per cent respectively – almost unbelievably, the same maps were used in Glantz's 2005 book on the Red Army without the error being corrected.[27] It is hence vital to use proper geographical sources as well as these purpose-drawn maps. As I show in Chapter 10, innovations such as Google Maps and Google Earth have now revolutionised our ability to gain information on even the most obscure and remote battle areas, but one must never forget how much terrain can change over time as vegetation and human infrastructure develop and as rivers and shorelines change their course, so period maps and photographs offer an equally important research resource.[28] Finally, designers should bear in mind that the geographic localisation of past engagements is itself often uncertain and contested, as shown by recent rethinking concerning the site of the Battle of Bosworth.[29]

When it comes to the **orders of battle** of the contending forces, disagreements between sources become routine, as I have already shown with regard to Stalingrad. This stems partly from inaccurate intelligence about enemy forces, partly from propagandistic distortions that seek to magnify the odds friendly forces face, and partly from the sheer complexity of keeping track of the constantly shifting dispositions of so many individual units and personnel. Except in naval warfare, tracking the presence, location and theoretical composition of particular units is only half the battle, since (as I show in Chapter 10), the real effective fighting strength of such units may vary wildly from day to day due to equipment serviceability, fatigue, casualties, straggling, and detachments or attachments at the subunit level.[30]

Caesar tells us that the two legions with which he arrived in Alexandria in 48bc totalled only some 3200 men, whereas their theoretical complement was around three times that.[31] This does not, of course, mean that his army had only one-third of its initial effectiveness, since his remaining troops were presumably the hard core of an already veteran force – yet another qualitative aspect that designers must seek to weigh up from the evidence available. Researching orders of battle is a matter of comparing as many situation maps and strength returns as possible, so as to identify disagreements and to have some means of gauging which version seems the more reliable. Simulation designers also need to investigate the arrival of reinforcements and the withdrawal of engaged forces during the actual battle, and to make at least some effort to discern how this might change if events develop differently.

The third research topic involves understanding the **generic capabilities** of the engaged forces. Here, all four of the source categories I discussed earlier come into play as a means of discovering what factors affect the movement rates of the various forces, how much space they occupy in different offensive and defensive formations, what supplies they need to continue functioning effectively and, above all, what happens when they engage in combat. How do factors such as range, terrain, unit orientation, numbers, morale and leadership influence the rate at which particular forces can damage the enemy and the rate of damage they themselves sustain? Is combat a mobile affair in which outmatched forces can retreat so as to trade space for time, or does it involve temporary disruption or permanent attrition of the engaged forces? How do the different combat arms interact, and are combined arms tactics crucial for success? What are the pros and contras of attacking or of adopting a tactically defensive approach? A key technique for investigating such questions with regard to real past engagements is to construct a kind of ‘storyboard’ for the conflict in the form of a series of maps showing the location and strength of the various units at successive intervals during the actual battle or campaign. This can then be used to measure movement rates in different circumstances, and to identify the occurrence and outcome of different kinds of combat. If the simulation is of an entirely hypothetical past or future conflict, such a storyboarding approach is not available, and designers must instead try to work out the generic capabilities of the engaged forces more from first principles, using technical data and comparative information from other similar contests.

The final broad research topic concerns the **decision environment** facing the real commanders. Coming to grips with this subject requires first of all that researchers explore the command and control infrastructure available to the actual antagonists, in terms of the pace and reliability of transmitting reports and orders and the time required for new plans to be devised and implemented at the various levels of the command hierarchy. This should give a sense of whether each force is more akin to a set of chess pieces under responsive unified control, a supertanker that is hard to shift from its established trajectory, or a swarm of bees that operate in uncoordinated ways according to their individual initiative.[32] For historical conflicts, designers must then use sources such as memoir literature to understand why commanders at various levels made the tactical and strategic decisions they did, especially when those decisions seem in hindsight to have been flawed or suboptimal.[33] How blinded were the two sides by deception measures and the 'fog of war', and were there major intelligence asymmetries like those created by *Ultra* in World War Two or by satellite surveillance in the 1991 Gulf war?[34] What role was played by jealous rivalries, political sensitivities, or stultifying superior orders like those from Adolf Hitler?[35] How far were military realities disastrously misperceived, as in the 'cult of the offensive' which encouraged bloody and fruitless attacks like those by France in 1914 and Italy in 1915–17?[36] How did individual geniuses such as Alexander the Great and Napoleon have such a powerful impact that Wellington rated the latter's presence on a battlefield as equivalent to 40,000 troops?[37] For hypothetical conflicts, the potential effects of such human idiosyncrasies are much harder to identify, so there may very well be a tendency to underrate the importance of the decision environment in non-historical simulations.

Hindsight obviously makes it easier to simulate known historical conflicts than to simulate hypothetical past or future conflicts with anything like the same degree of confidence. This is neatly illustrated by Dunnigan's game *Sinai*, which he designed in 1973 to cover the 1956 and 1967 Arab–Israeli wars and also a further potential conflict in the mid-1970s. Late in the design process, the real Yom Kippur War occurred, and the game system had to be hurriedly adapted to reflect the unexpected way in which the Arab antitank and antiaircraft missile defences curtailed the previous dominance of the Israeli tanks and jets – the quadrupling of the printed defence strength of Arab units gives a sense of the magnitude of the change required.[38] Two decades later, a

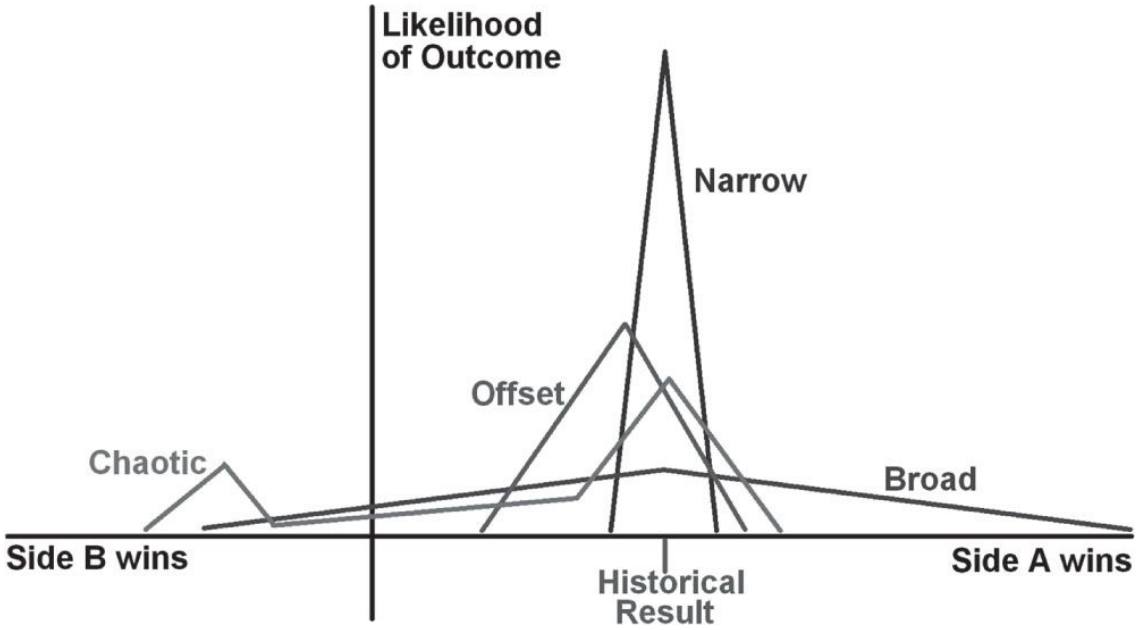
similar phenomenon occurred in reverse, when Ty Bomba's *Desert Storm* simulation, which he first designed in advance of the operation itself, had to have extensive 'idiot rules' incorporated to handicap the Iraqis and so make the contest as one-sided as it actually turned out to be.[39] Bomba later designed several editions of a *Back to Iraq* game in advance of the actual US invasion in 2003, but they gave little sense that the real challenge this time would lie not in conquering the country but in tackling the subsequent insurgency.[40] These various lapses of foresight were by no means unique to recreational wargamers, and many professional analysts made exactly the same mistakes, but they do show how hard it is to design a credible simulation without the benefit of hindsight.

Even knowing in some detail how a historical engagement turned out takes us only part of the way towards having the information necessary to simulate it, since simulation modelling is a far more ambitious process than mere narrative description of the events concerned. Wargames bestow in miniature the almost God-like ability to rewind time over and over again and to experiment with all kinds of random variations and alternative decisions, thereby creating the ultimate counterfactual sandbox. The trouble is that the only really reliable data on which to base this model come from a single historical 'trial'. It is rather like being asked to guess the contents of a person's entire wardrobe based on the clothes that person wears on a single day. Knowing about this one outfit is certainly a lot better than having nothing to go on at all except the person's age and gender (which equates to the situation when modelling an entirely hypothetical conflict), but it still leaves a great deal of room for speculation and guesswork. How big and varied is the full wardrobe? Are the clothes the person is wearing typical or atypical of their usual attire (as with a pinstriped executive who dresses down at weekends)? Does the wardrobe include any unusual items such as scuba gear? All these questions mirror similar uncertainties experienced when modelling a specific historical conflict, as I will now discuss.[41]

Wargames allow repeated refights of the same battle or campaign, and these will slowly generate a statistical spread of outcomes due to variations in luck, player skill and player decisions. One key issue is the width of this probability distribution. Is it possible for the underdog to win a real military victory 'against the odds', or is the spread of results so tightly packed that the superior side is bound to prevail? In other words, does the designer think that the historical outcome of the engagement was pretty much inevitable, or just one (albeit a plausible

one) of a widely spread range of possibilities? A second, related question is whether the real outcome should lie in the centre of the wargame's probability distribution, or off to one side. Was one antagonist in the actual battle or campaign unusually fortunate, such that most wargame refights should see that side doing less well?[42] Finally, what shape should the probability distribution be? The classic 'bell curve' is only one option among many, and it is entirely possible for wargames to generate more 'chaotic' outcomes based on the 'butterfly effect' so familiar from climate science.[43] An unlikely event such as the death of a charismatic leader such as Alexander the Great, or the Axis capture of a key point such as London, Moscow or Malta in World War Two, can easily be made to trigger an accelerating collapse of the affected side. The overall result is that a single historical conflict is potentially compatible with an infinite array of different wargame probability distributions, as illustrated in Figure 4.1.

Some observers suggest that even this daunting level of uncertainty fails to capture the yawning unpredictability of the real world. In his book *The Black Swan*, Nicholas Taleb derides what he calls 'the ludic fallacy', and he argues that, 'the attributes of the uncertainty we face in real life have little connection to the sterilized ones we encounter in exams and games'.[44] Taleb's point is that games are an artificial environment within which risks are bounded and statistically calculable, whereas reality is unbounded and infinitely complex, and so catastrophic events such as the September 11 attacks or the recent financial crash, BP oil spill and Arab revolutions loom up from entirely unexpected directions to confound the best efforts of 'trend spotters' and 'risk managers'. Wargame theorist Peter Perla has recently endorsed this view, arguing that 'analyst games' that seek to 'model, predict, and explain the real world, including human behavior and randomness, with the precision of a physicist calculating ballistic trajectories' need to give way to 'experience games' whose main aim is to prepare decision makers to cope with the unexpected. In Perla's words: 'Our models, at their best, predict the past; Analyst wargames tend to imprison their players too tightly in that past for them to lift their eyes high enough to see the circling Black Swans.'[45]



4.1 Some possible distributions of outcomes for historical simulations

Although this objection has considerable force, it should not be taken too far. Humans are not mere helpless victims of an utterly uncertain world, but are capable of shaping their futures to a very considerable extent by taking actions founded on past learning and experience. Modern societies are based entirely on such planning and predictability, with people assuming that their wages will be paid, that food, water and electricity will be delivered, and that transport arrangements will function to take them to and from distant appointments. It is precisely because people have learnt to take such things so much for granted that occasional 'Black Swans' like the Icelandic volcano that grounded air travel in the spring of 2010 come as such a shock. When it comes to war and conflict, planning is, of course, much less reliable, because of the presence of another armed group actively seeking to undermine your own plans and to achieve their own contrary ones (as I noted in the Introduction). However, the resulting uncertainties stem far less from a radically greater incidence of 'Black Swan' phenomena than from the complex but intelligible dynamic interactions of military forces and strategic decisions within a given overall geographical and political environment. Wargames seek to model exactly these dynamic interactions, and hence to show (for example) why it was so much more likely that Germany would conquer Poland in September 1939 than vice versa, even though the precise course of the fighting was far more difficult to predict and will tend to vary each time the contest is refought.[46] This variation is a very salutary corrective to conventional historical accounts that often give

little or no sense of contingency, as if what happened was somehow ‘bound’ to occur.

The bottom line is that wargame design is always about making the best of a bad job, however detailed and extensive the research on which the project is based. As Figure 4.1 shows, so many judgements need to be made about counterfactual variables that educated guesswork must of necessity play as great a role as objective representation during the design process. This applies especially to games about purely hypothetical past or future conflicts, but even simulations of actual past engagements are subject to similar uncertainties because of the availability of only a single real-world ‘trial’. However, wargame modelling remains a very worthwhile endeavour, not just because of its educative functions as discussed in Chapter 3, but also because of the research insights it can provide. I will return in Chapter 8 to the vexed question of how conflict simulations may be ‘validated’ against actual experience, but I will turn now to examine the utility of wargames as research tools in their own right.

Just as the use of wargames for education and training has hitherto been a predominantly military endeavour, so the use of wargaming as a research device has been far more a matter for military professionals and defence analysts rather than civilian academics. Professional analysts have focused very heavily on modelling potential future engagements, as a means of predicting conflict dynamics and so gaining insights to help shape strategy and force planning. Although (as I have explained) such hypothetical future simulations are the most problematic of all in terms of accurately reflecting real conflicts, and the most susceptible to error and distortion because of the absence of any ‘reality check’ in the form of actual experience, military professionals over the past century have seen this technique as a useful supplement to simple intuition as a means of deciding what forces to develop and what strategies to adopt should war come.

In the years before 1914, wargaming helped to persuade the British that a continental commitment was needed to safeguard France against outflanking through Belgium, and it also helped the Germans to devise just such a move in the form of the Schlieffen plan. Wargames showed both Germans and Russians the potential vulnerability of a two-pronged assault on East Prussia to defeat in detail, but it was the Germans who took this lesson to heart and applied it at Tannenberg.[47] During the interwar period, Doenitz used

wargaming to develop his wireless-based ‘wolfpack’ tactics for U-boat attacks, while US Admiral Nimitz later claimed that: ‘The war with Japan had been re-enacted in the game rooms here by so many people and in so many different ways that nothing that happened during the war was a surprise – absolutely nothing except the Kamikaze tactics toward the end of the war; we had not visualized those.’[48] Wargaming continued apace during World War Two itself, including the notorious Japanese game before Midway in which a combination of optimistic umpiring and failure to take on board the lessons of the game blinded the Imperial fleet to the weakness of its plans.[49] Montgomery often played through forthcoming operations with his staff, and the Germans (as the original progenitors of *Kriegsspiel*) used wargaming routinely to try to offset the growing odds they faced – the Normandy invasion caught several German officers on their way to Rennes to game their response to just such an attack, and when a similar wargame in November was interrupted by a US offensive in the Hürtgen forest, the Germans continued the game and issued some of the orders for real.[50]

As I discussed in Chapter 1, Anglo-American modelling of combat from the 1940s onwards tended to shift towards the more ‘scientific’ techniques of operations research and game theory. ‘Stochastic’ elements involving random variation were often still present, but individual games between human participants tended to be overshadowed by ‘Monte Carlo’ simulations in which computers ran the new models over and over again so as to generate automatically the kind of statistical patterns illustrated in Figure 4.1. This had the advantage that the overall results were less variable and more reproducible than in one-off games between human players, and so appeared more robust and convincing as a basis for procurement of weapons systems that were becoming ever more expensive.[51] However, traditional wargames with human decision makers still survived alongside these automated simulations, not just for the educational and training purposes that I discussed in Chapter 3, but also as a tool for providing research insights into the nature of future conflict.

Israel involved close subordinates to actual decision makers in its games, so that they would reflect as realistically as possible the perennial clashes in which it was embroiled.[52] In the United States and other western countries, ‘Pol-Mil’ gaming became established, as defence establishments tried to look beyond the purely military

dimension and to come to grips with the challenge of intractable conflicts such as Vietnam.[53] From 1979, the US Navy ran an annual three-week long Global War Game involving hundreds of military and civilian participants, and this helped to shape the new 'Forward Maritime Strategy' adopted during the 1980s.[54] Partly due to input from hobby game designers such as Herman, wargaming played a significant role during Operations Desert Shield and Desert Storm in 1990–91, with the US Marine Corps alone conducting six manual or computer-assisted wargames during this period.[55] Some recent professional games have been designed expressly to research the decisions and situational awareness of their human participants, including one game, 'Scud Hunt', which is rather like a cooperative version of my own simple 'Gotcha!' game as described in Chapter 3.[56] Professor Robert Rubel of the US Naval War College argued recently that traditional wargaming techniques need to be adapted to cope with the new paradigm of 'Network Centric Warfare', but that games with human players remain relevant alongside automated simulations as long as the games are carefully designed and are seen as offering suggestions rather than certainties in response to challenges too complex to be amenable to 'engineering solutions'.[57] In Rubel's words: 'We war-game because we must. There are certain warfare problems that only gaming will illuminate.'[58]

So what about wargames that simulate historical conflicts? Can they tell us anything new, given that we already 'know' what happened in reality? I pointed out earlier in this chapter that the enthusiasts who design such games sometimes undertake a level of primary research that outstrips that of some professional historians, who are less driven to discover the detailed minutiae of the campaigns they describe. Wargamers blanch at such mistakes as Overy's statement that the encirclement of Kiev in autumn 1941 involved 'the First Panzer Group from the north and the Second Panzer Group moving from the south', rather than vice versa.[59] However, such points can easily be dismissed as mere pedantry, especially since wargames often contain equally glaring errors and distortions of their own. Is there anything about the *technique* of wargaming that makes it a valuable tool of historical analysis, compared to the more traditional approach of selecting particularly telling evidence from the mass of research data and using this material to buttress a considered interpretation and argument in the form of an article or book? I think there is, and I will now suggest six ways in which wargame-style modelling of historical

conflicts can offer useful research insights, drawing in particular on my own work as a war studies academic over the past quarter of a century.[60]

First, unlike the words and charts of traditional works of military history, which are the author's uncritical slaves and so meekly transmit even glaring errors like those in Glantz's maps, wargames are living and evolving systems that can provide feedback to highlight deficiencies in the designer's current level of understanding. Wargame designers cannot simply describe how a battle progressed, but must instead build up a dynamic working model consisting of a map, moveable units, a set of rules, and players seeking the best way to prevail. Trying to make this intractable combination of elements yield even a half way decent simulation of reality throws up all sorts of questions and problems that traditional authors never face from their own utterly submissive words and line drawings. In McCarty's words: 'As a tool of research … modeling succeeds intellectually when it results in failure, either directly within the model itself or indirectly through ideas it shows to be inadequate. This failure, in the sense of expectations violated, is … fundamental to modelling.'[61] I have already described how the inaccuracy of the map in Dunnigan's draft game on the battle of Smolensk was revealed when playtests failed to follow history.[62] There have been many similar incidents during my MA course in conflict simulation – one that springs to mind is when the Union player in Nicholas Inns's draft game of the Wilderness campaign of 1864 simply sent his forces round rather than through the Wilderness, prompting the designer to undertake further research to see why this did not happen in reality.[63] In *Lost Battles*, I use the dynamic modelling inherent in wargames as a key means of raising such questions, as at Cannae, where it is hard to see why Hannibal concentrated his cavalry striking force in the confined space between the infantry and the River Aufidus if the other flank were as wide open as some scholars suggest.[64]

This leads neatly into the second reason for the utility of historical wargaming as a research device, namely that some engagements (especially those from pre-modern times) are so thinly and unreliably recorded in the surviving evidence that scholarly reconstructions using traditional techniques diverge widely depending on the particular 'hunches' favoured by the different scholars concerned.[65] Military men have often tried to resolve these uncertainties by bringing their own experience to bear (a technique that Burne described as 'inherent

military probability'), but what seems clear common sense in one era may be misleading in others – Delbrück, for example, ridiculed claims from classical antiquity that the outnumbered army usually prevailed, but such triumphs of quality over quantity seem much more acceptable from a modern perspective than in Delbrück's own day a century ago when victory usually went to the 'big battalions'.[66] It seems much safer to assess past eras in their own terms rather than by importing our own modern prejudices, and wargame modelling offers a structured way of doing just that. The central methodology of *Lost Battles* is that I use evidence from antiquity to develop a unified comparative model of ancient land battle that I then apply to 35 individual engagements to cast light on which scholarly reconstructions fit most closely with patterns observed elsewhere.[67] This technique of 'comparative dynamic modelling' could be applied to other eras and other forms of combat, and it shows the potential of simulation gaming as a research device.

The third valuable attribute of wargame modelling is that it encourages historical researchers to be more rigorously logical in their analyses of combat dynamics. For example, Wargame Developments member John Salt calculated recently that, even during World War Two when automatic weapons had not yet become universal, a typical infantry unit could fire off all the ammunition it could carry within five minutes, and hence that the dominant experience of troops during the many hours that real firefights are recorded as lasting must have been one of waiting rather than shooting.[68] This relates intriguingly to the more psychologically focused studies by S.L.A. Marshall and others of infantry combat in World War Two and Korea.[69] In similar vein, I worked out fifteen years ago that some infantry *melées* in antiquity must have lasted hours rather than mere minutes as in Hollywood depictions, judging simply by the 'battlefield clock' provided by the simultaneous movements of other forces at clashes such as Cannae, the Metaurus and the Sambre. I realised that this was incompatible with previous academic images of continuous shoving or sword duelling, because these would surely produce unsustainable exhaustion and far higher casualties for both sides than the victors usually suffered, and so I developed an alternative model of infantry combat as a close range standoff punctuated by sporadic surges into contact.[70] This model has since attracted much support, since it fits with the many references to missiles being used throughout pre-gunpowder clashes, as well as with better documented recent

experience of such standoffs in nineteenth-century battles and in modern confrontations between rioters and police.[71]

A fourth key contribution of wargaming, as I mentioned in the Introduction, is that it serves as a constant reminder that warfare is a dynamic and interactive contest rather than a unilateral endeavour. Many scholars favour Liddell Hart's definition of strategy as 'the art of distributing and applying military means to fulfil the ends of policy', but I much prefer Beaufre's formulation that it is 'the art of the dialectic of two opposing wills, using force to resolve their dispute'.[72] My first instinct when analysing any kind of conflict is to strip it down to its bare agonistic essentials, just as if I were designing a wargame to portray the tactical or strategic contest concerned. This has proved very helpful when trying to understand intractable topics such as the constant escalations and de-escalations of air and missile attacks during the Iran–Iraq war of the 1980s, or the factors strengthening or undermining restraint in the use of chemical, biological and nuclear weapons over the past century.[73] My more recent research on various different aspects of air power over the past 100 years has benefited similarly from the interactive lens that wargaming provides.[74] This is especially evident from my work on air superiority contests and peace support operations, which makes heavy use of game theoretic matrices, and from my research on 'air strategy and the underdog', which builds on a long-running staff college exercise that I devised to remind Air Force officers that (despite western aerial dominance) it was vital to take enemy reactions to their operations into account.[75] Finally, my long experience of simulating both ancient and Napoleonic warfare led me to realise that (contrary to Michael Handel's claims) Sun Tzu and Clausewitz really do differ in their strategic precepts, and that this difference is explained at least in part by the different character of warfare in their respective eras.[76]

A fifth research payoff of historical wargames is that they allow much more structured exploration of causality, contingency, and counterfactual possibilities. Once a contest such as the Waterloo campaign has been modelled as a wargame, and has been tweaked so that historical choices tend to produce broadly historical results, it is simplicity itself to experiment with minor changes such as different weather, less dilatory French attacks at Quatre Bras or Waterloo, more effective use of d'Erlon's corps on 16 June or different manoeuvres by Blücher's or Grouchy's troops on 18 June.[77] Although the results of such experiments will inevitably depend to some extent on the

designer's systemic choices as programmed into the game rules, the distributions of outcomes in Figure 4.1 are at least as much situationally as subjectively determined, because a wargame is a living process and not just a mute reflection of its designer's will. For example, simulations of Operation Market Garden in September 1944 naturally tend to produce a wide range of outcomes because overall Allied success can be threatened catastrophically by Axis tactical victories at any point along the long highway to Arnhem, whereas simulations of Eisenhower's entire 'broad front' offensive in 1944–45 involve less variation as the outmatched Germans are gradually driven back all along the front.[78] Wargames that focus entirely on counterfactual possibilities such as an early German drive on Moscow in August 1941 or an Axis invasion of Malta in 1941–42 are necessarily more subjective, since they rely wholly on technical and comparative data and have no direct historical precedent.[79] Even here, however, very useful insights can be gained if sufficient technical and comparative evidence is available, as with the 1974 Sandhurst wargame of Operation Sealion, which involved real commanders such as Adolf Galland, and which suggested that a German invasion of Britain would have been foiled when the Royal Navy cut the supply lines across the Channel, even had the Germans somehow managed to suppress the RAF and get an initial wave ashore in the first place.[80]

This leads into the sixth and last research contribution of historical wargames, namely that the models they contain serve as a very useful foundation for predictive simulation of potential future conflicts. The strongest argument for professional officers and defence analysts to take recreational wargames seriously has always been that these hobby games are 'history based', allowing their models to be 'validated' against real experience (unlike the necessarily more speculative simulations of future warfare used within the defence community itself).[81] Especially now that the Cold War is over and real combat operations have replaced deterrence as the main activity of western armed forces, professional analysts are keen to develop models that simulate recent and ongoing conflicts as well as potential future ones, so as to give their simulations credibility with often sceptical audiences.[82] My own studies of future warfare have always been firmly rooted in historical experience, and I have already described how other analysts such as Biddle, Dupuy and Rowland have put history at the heart of their own modelling efforts, drawing on examples as far back as a century ago and further.[83] Although it might

be thought that the current preoccupation with counterinsurgency operations has made the conventional fighting of the world war era irrelevant, Biddle and Friedman take precisely the opposite view, and argue that Hezbollah ground forces in Lebanon in 2006 employed hybrid defensive tactics that can be dated back to German practice in 1916.[84] The dividing line between historical and predictive wargames is hence anything but firm, and designing accurate simulations of conflicts that have already taken place is of far more than merely 'antiquarian' interest.

Overall, the greatest strength and also the greatest weakness of wargaming is its awe-inspiring ambition. Instead of being content with simply describing what research tells us about past conflicts, wargames seek to capture such conflicts within complex 'working models', which can in principle be used to examine any desired counterfactual question about that past campaign, or which can be ported across to provide a 'crystal ball' offering advance insights into how future engagements might develop given a certain set of initial conditions.[85] The penalty for this vaulting ambition is that even well-researched conflict simulations inevitably rely on a web of subjective design judgements that lead sceptics to doubt their value as a source of any kind of reliable insights. My own feeling is that wargames are rather like weather forecasts – their reliability diminishes quickly the further they look beyond what we already know, and their occasional spectacular mistakes give them a very bad reputation, but, on balance, they do offer us a marginally better understanding of the world as a whole.[86] Perhaps the greatest attribute of wargames is that they are living systems, which involve their users to a far greater extent than mere words and line drawings. My *Lost Battles* not only sold better than most traditional works of academic history, it also prompted hundreds of readers to join in lively and erudite online debates on the associated Yahoo! discussion group, which continue to this day and which already amount to well over twice as many words as there are in the book itself![87] We recently published a deluxe 'game edition' of the book, including mounted maps, die-cut counters and full-colour rules and charts to make it even easier for readers to study and refight the engagements concerned.[88] If this present work achieves even a fraction of that success, it will confirm my own personal experience over the past three decades that wargaming can be a highly thought-provoking and inspirational way of studying the awful phenomenon of armed conflict.

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BIG WEEK
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REFUELLING
REARMING
LANDED
Stade
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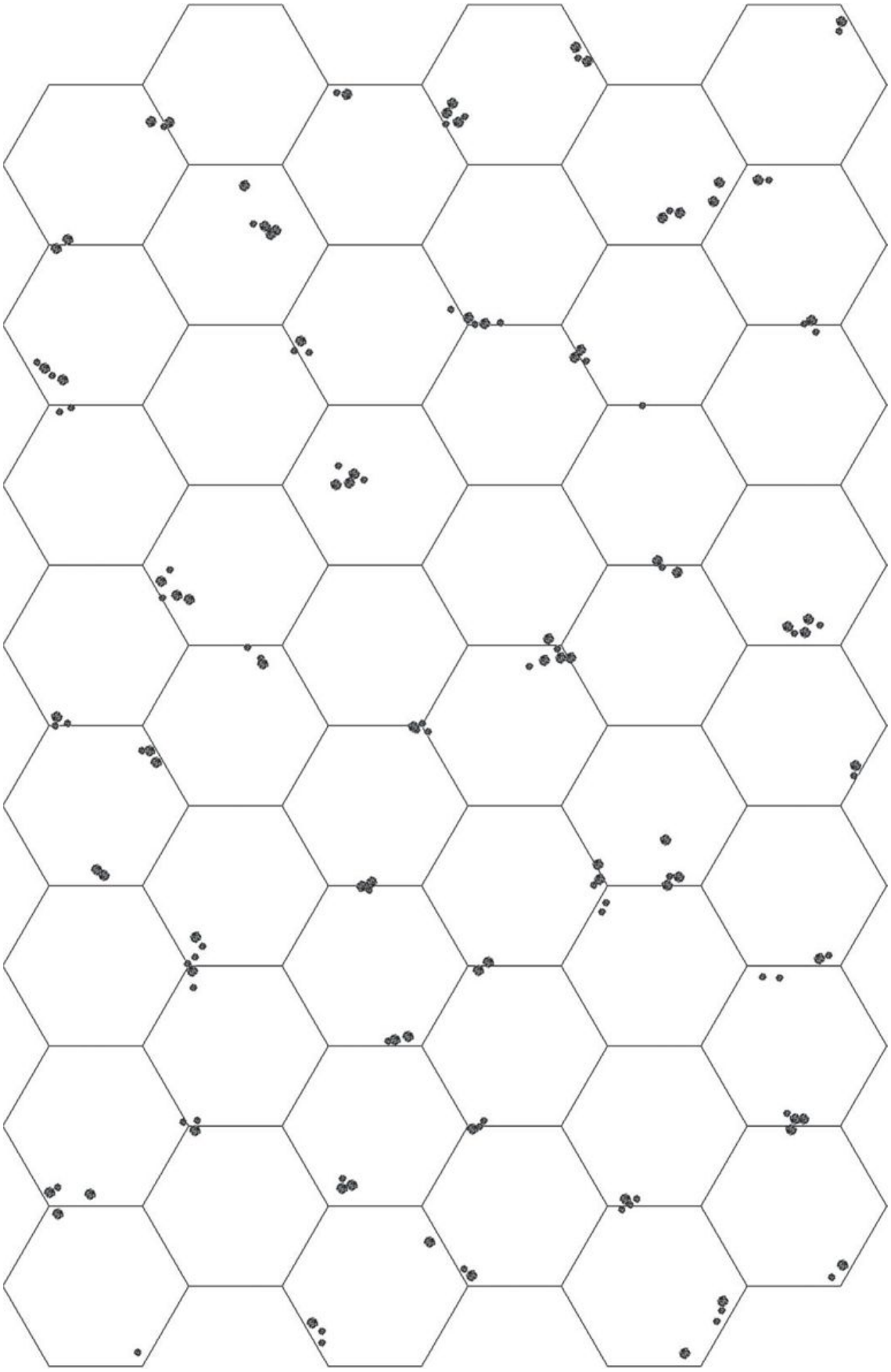
Schleisheim
Stuttgart
Augsburg
SWITZERLAND



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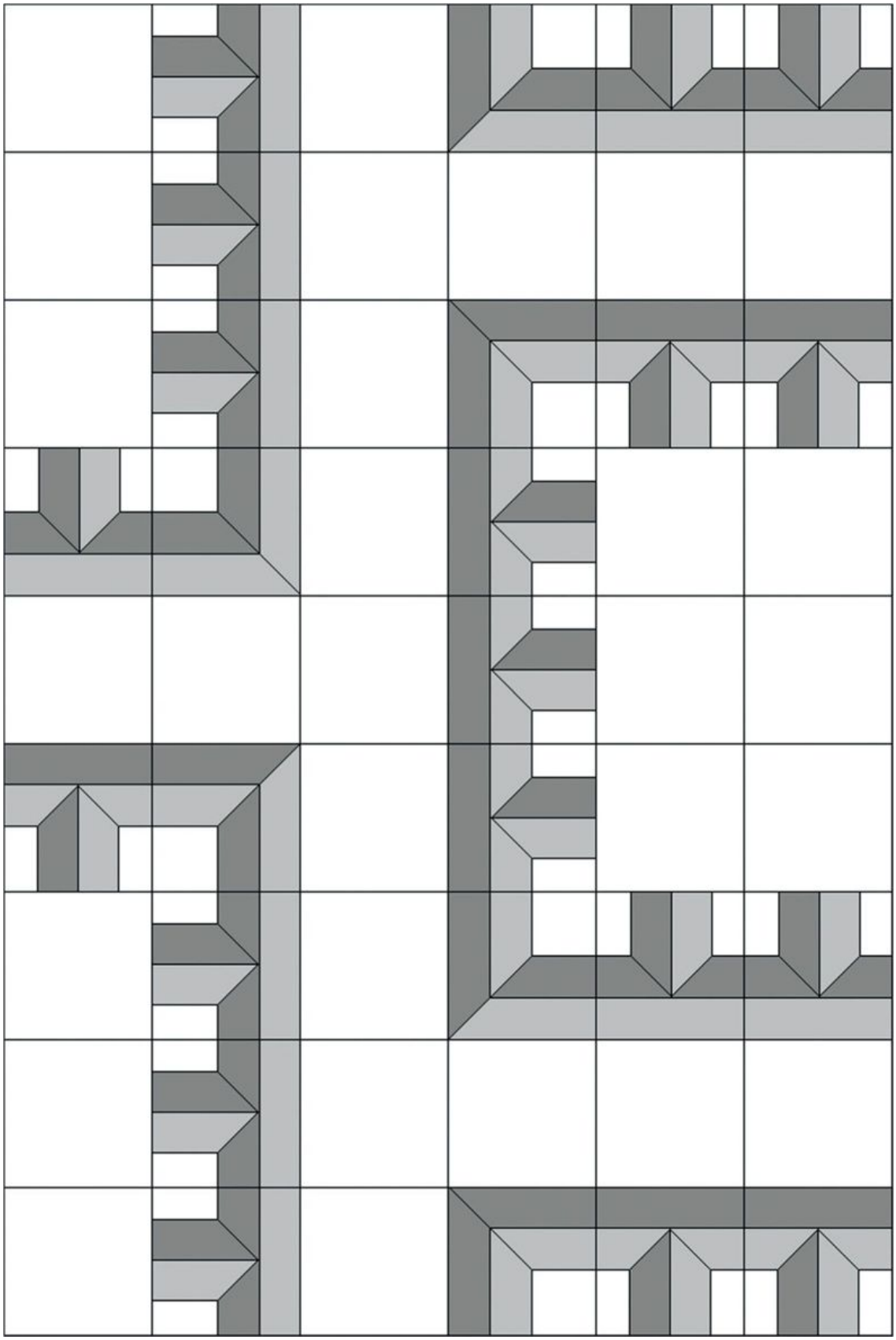

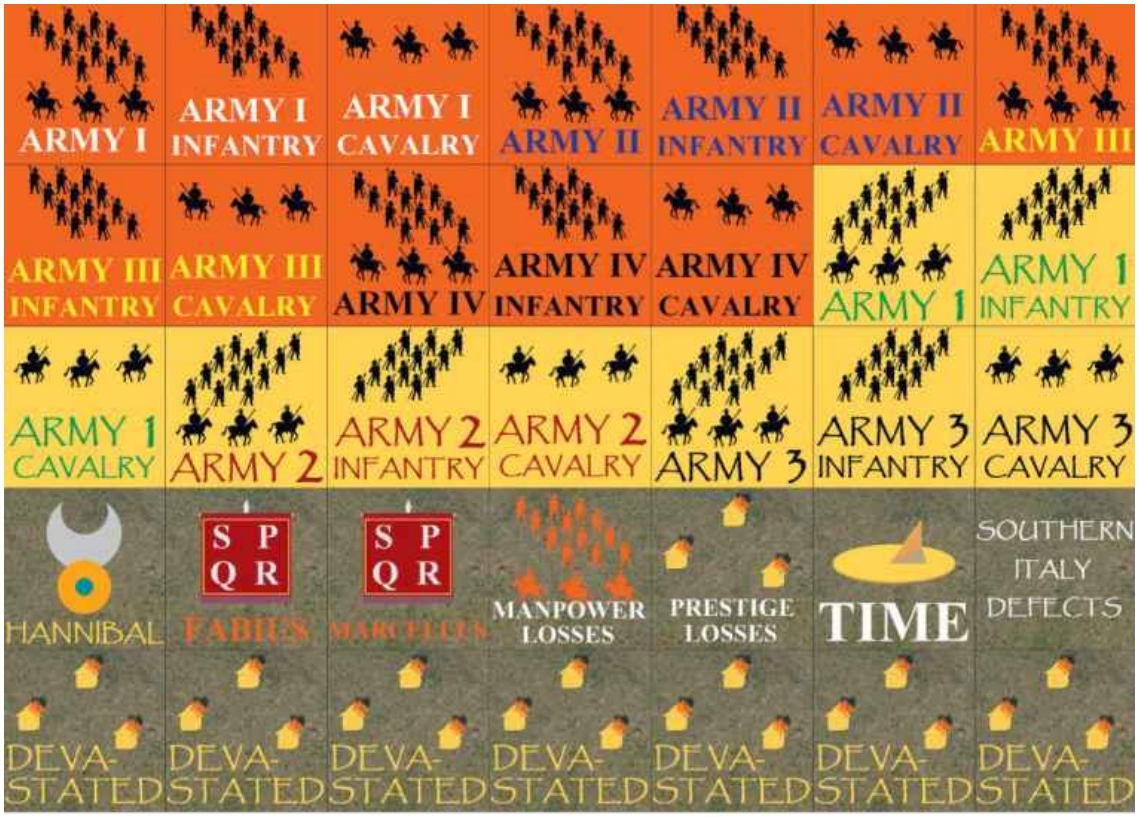
ARMY I
ARMY I INFANTRY
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ARMY II CAVALRY
ARMY III
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ARMY IV
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ARMY 1
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ARMY 3
ARMY 3 INFANTRY
ARMY 3 CAVALRY
HANNIBAL
S P Q R
FABIUS
S P Q R
MARCELLUS
MANPOWER LOSSES
PRESTIGE LOSSES
TIME
SOUTHERN ITALY DEFECTS
DEVA-STATED
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DOWN P-47
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DOWN P-47
DOWN P-47
DOWN P-51
DOWN P-51
DOWN P-38
FORM-ATION 1
FORM-ATION 2
FORM-ATION 3
8th AIR FORCE LOSSES
B-17
B-24
B-24
DOWN P-38
FORM-ATION 4
15th AIR FORCE LOSSES
READY LAND Me 109 FUEL ARM
READY LAND Me 109 FUEL ARM
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LUFT-WAFFE LOSSES
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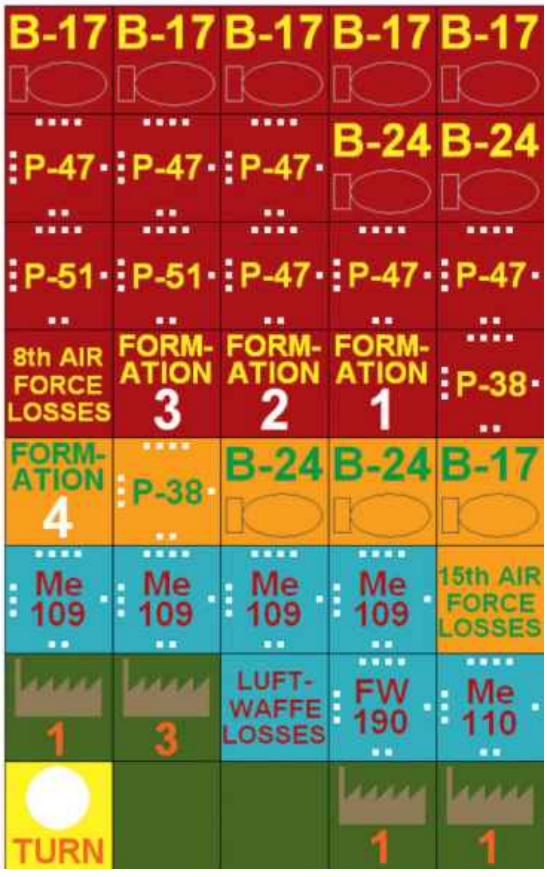
TURN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8th AIR FORCE LOSSES
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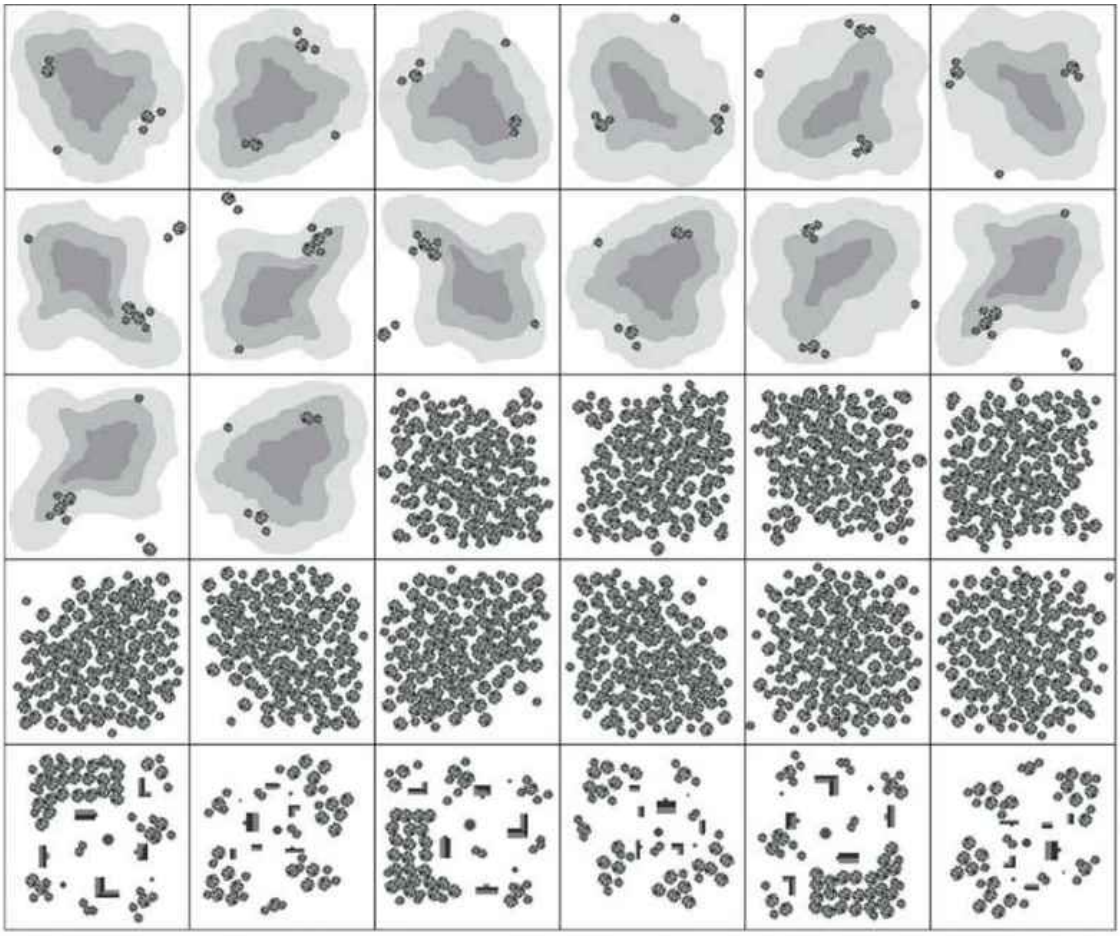


A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	C-3	D-1	D-2	D-3	MMG
1-a	1-b	1-c	2-a	2-b	2-c	1-a	1-b	1-c	2-a	2-b	2-c	MTR

MMG	D-3	D-2	D-1	C-3	C-2	C-1	B-3	B-2	B-1	A-3	A-2	A-1
	2-c	2-b	2-a	1-c	1-b	1-a	2-c	2-b	2-a	1-c	1-b	1-a

PART II

Mechanics

5

Designing the components

Is wargame design an art or a science? It certainly has scientific elements, such as the fact that the entire physical system (map, counters and rules) could be expressed if desired in purely mathematical terms, and could be programmed into a computer as a string of ‘1’s and ‘0’s by someone with the necessary expertise. The way in which simulation models are continually tested and refined so that they more closely reflect reality also echoes the way in which scientific hypotheses are generated and refined. However, leading wargame theorist Peter Perla is very clear that ‘designing a wargame is an art, not a science’, likening it to painting, since it is dominated by individual style and fashion and has no formal rules of pitch and grammar as do music and literature.[1] Veteran wargame commentator and designer Charles Vasey used exactly the same analogy during a recent debate with me over design principles, stating his own preference for a more ‘impressionistic’ technique, and urging ‘that we adopt the approach of Monet, who noted that he did not paint light but the appearance of light’.[2] Professor Robert Rubel of the US Naval War College made the same point in a more negative way when he wrote: ‘Valid knowledge can emerge from war games, but only if due diligence is applied. That diligence is considerably hampered today because war gaming is a craft or an art, not a true profession, a discipline. Much more work must be done. Those who believe in the value of games must now link up and work toward the goal of truly professional war gaming’.[3]

As I have already discussed on several occasions, these tensions are rooted in the multiplicity of purposes for which wargames are designed, as embodied in the ambivalent connotations of the very word ‘game’. Some wargames are focused more on enjoyment than on simulation, and so realism is

sacrificed if it gets in the way of player satisfaction – as I said in Chapter 2, mass market computer games such as the *Total War* and *Call of Duty* series are especially vulnerable to this prioritisation.[4] By way of contrast, many recreational wargames are more obsessively detailed and well researched than the work of some 'professional' wargamers and historians – the word 'recreation' itself has an interesting double meaning in this regard. Charles Vasey says that he is just a hobbyist and has no historical pretensions, but he laments the recent fashion for 'history-lite' games, and his own wargame designs on the English Civil War and the battle of Mars-la-Tour in 1870 are the most accurate and 'serious' simulations ever produced of these conflicts.[5] Although I agree with Rubel that wargames can be a valid source of insight, and although I do wish that recreational games would not undersell themselves so often by omitting to include bibliographies showing the research on which they are based, I think that Rubel's suggestion of establishing a professional 'guild' of wargamers risks taking us in precisely the wrong direction. It smacks of an exclusionary and expert-led approach, whereas my whole thrust in this book is to make wargame design more widespread and inclusive, so that users can act as 'intelligent customers' to sort the wheat from the chaff, or can produce simulations tailored to their own precise needs by drawing the best ideas from the unregulated creative ferment of the past several decades.

As I discussed in Chapter 2, the real art in wargame design is to reflect the almost infinite complexities of warfare within a model that is simple enough to be played but still subtle enough to capture the key dynamics of the actual conflict it seeks to portray. In painting, whether one prefers the blurry impressionism of Monet or the almost photographic realism of Canaletto is purely a matter of taste, but in wargames, there is a direct trade-off between the 'resolution' of the picture presented and the ability to observe it at all, rather as if every image had to be downloaded laboriously using a cranky old 56k modem. Faced with this constraint, some wargame 'artists' opt to produce blurry microgames that browsing viewers can inspect with little delay, but which compare poorly with the detail that those viewers are used to seeing in reality, while other designers produce high-resolution pictures that look much more impressive, but which take so long to 'download' (i.e. to learn

and to play) that only a tiny minority of real enthusiasts ever experience them at all. As I said, I think that most published conflict simulations err too far in the latter direction, and my aim in this book is to make wargames more accessible by suggesting how to paint ‘blurry pictures’ while retaining as much as possible of the representational fidelity missing in so much of modern art.

This issue of ‘resolution’ is of very direct relevance to my first topic, namely how to reduce the inordinate complexity of real terrain and real military forces and populations into a simple enough form that players can manipulate them just as if they were pieces on a chessboard. (Note that I am postponing discussion of the morality of such an approach until Chapter 10, when it comes most sharply into focus in the context of the appalling bloodbath of World War Two.) The usual technique is to amalgamate the many individuals and pieces of equipment taking part in the conflict into a more manageable number of composite ‘units’ (each one represented in boardgames by a single cardboard counter), and to split the battle area into a number of zones or regions which are given unified properties for the purposes of the game (in rather the same way as the UK is divided into several hundred constituencies, each of which elects a single member of parliament, allowing the whole of the country to be represented as a patchwork quilt made up of just a few different shades of colour denoting the different parties). How many separate units and how many distinct zones the wargame contains are major determinants of the ‘resolution’ of the simulation, and the two issues are very closely interrelated, for reasons I explore later in the chapter. First, however, I must discuss the key design decision of how large an area to include in the simulation at all.

Sometimes geography helps with this choice, because the fighting is constrained by ‘no-go’ areas such as neutral countries or impassable terrain. Wargames of the US assaults on small Japanese-held islands such as Tarawa, Saipan and Iwo Jima benefit from the fact that the fighting was essentially confined within the encircling shoreline.[6] More usually, designers must make an arbitrary decision as to how far beyond the immediate battle area their map should extend. If it stretches too far, then there will be a lot of wasted ‘dead space’, the resolution of the simulation will be further reduced, and there may be a tendency for players to

exploit the extra flexibility in unrealistic ways. For example, wargames on the ill-fated German offensive at Kursk in 1943 often prompt German players to avoid the dense Soviet defences on the north and south of the salient and to attack the more thinly held western face instead.[7] Contrariwise, if the map is too constrained, the alternative strategic options open to players may be unduly limited, and the map edges may create an entirely artificial 'end of the world' that players may use to anchor their flanks. This often happens in simple simulations of Gettysburg, with Union players forming their line right across the map from east to west instead of in the historical 'fishhook' position from north to south.[8] Sometimes one can square the circle of map coverage using abstract and smaller scale off-map 'boxes', perhaps even to link two or more related but geographically distant areas of heavy fighting as at Jena-Auerstadt in 1806, Crete in 1941 and in the Yom Kippur War in 1973.[9] In naval and air simulations, there may even be the possibility of creating 'endless' maps by moving empty map sections to accommodate forces about to leave the map elsewhere, as I will illustrate in Chapter 11.[10]

At the simplest extreme, one could imagine a very abstract wargame that does not use map or counters at all, but in which players merely keep a running total of the overall strength of their entire force, and use simple rules to determine how much damage they inflict on the enemy force in each period of fighting. Not even the very basic games I describe in Chapter 3 and Appendix 5 go to this extreme, since they all involve between four and fourteen different geographical spaces that the forces of the two sides may occupy and attack. The point of this subdivision is, of course, that real strategic and tactical choices revolve primarily around positioning one's forces in such a way as to gain an advantage over the opponent. Hence, Lanchester argued that the key to Nelson's victory at Trafalgar was that he defeated the rearward section of the more numerous enemy fleet before the front section could return upwind to relieve it, while Dupuy claimed that the German conquest of France in 1940 stemmed not from an overall force superiority (he put the ratio at only 0.87:1) but from the fact that the Germans amassed a 2.38:1 superiority in the key breakthrough sector in the Ardennes while holding the Allies at

0.47:1 odds elsewhere.[11] (The precise figures are dubious because, in yet another illustration of the problems with published statistics, the total of Dupuy's figures for the Allied strength goes from 3350 up to 3600 and back down to 3360 between the three relevant diagrams.)

As I mentioned in the Introduction, most figure wargames and a handful of board wargames do not divide the battle area into zones at all, but instead go to the other extreme and allow forces to occupy a potentially infinite number of different positions on the table or map, depending on the precise placement and orientation of the figures or counters concerned.[12] This might seem to offer an ideal of flexibility by doing without the artificialities of a grid, but, in fact, it requires the constant use of devices such as rulers and protractors (with all the associated potential for disagreement and 'creative' measurement), and it introduces all sorts of potential ambiguity with regard to the precise physical relationship of troops to one another and to terrain features.[13] Such objections are less significant in the more visually oriented context of figure gaming or in the umpire-led setting of military wargames such as *Kriegsspiel*, but it is noteworthy that even military games have generally moved away from freeform playing surfaces and towards the greater clarity offered by gridded boards.[14] Only with the advent of highly capable computers has it been possible to make grid systems less evident to players through masking techniques and the use of much finer resolutions – computers cannot, of course, cope with an infinity of possible positions, even though it might appear so to players of modern first-person shooter games.[15]

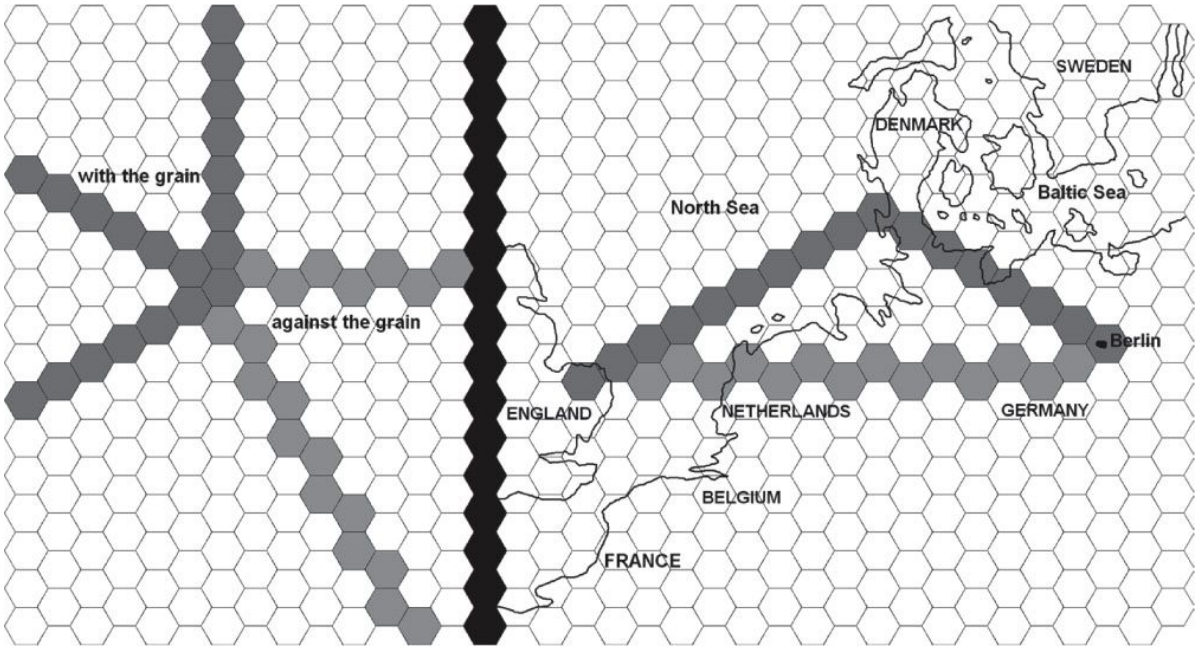
For board wargames, dividing the battle area into zones has the great advantages that the only positional information needed for each counter is which zone it occupies (just like the squares on a chessboard), and that terrain and movement can also be keyed to the zones so that there is no need for clumsy measuring sticks. Hence, the real choice is how many zones to use, and of what kind. There are two basic options – a regular grid of squares or hexagons, or an irregular patchwork made up either of adjoining areas (as shown in Chapter 9) or of boxes linked by communication lines. A regular grid is usually used in naval or air games to cover undifferentiated expanses of sea or airspace, or in

tactical games where unit facing is important as well as unit position. In other cases, the choice normally depends on the desired resolution of the zone system. Regular grids tend to be used to give a finer mesh, while irregular areas or boxes give a looser patchwork of fewer zones which can nevertheless be tailored to fit the shape of the actual terrain. A published boardgame map measuring the standard 22” by 34” would typically be divided into between 250 and 2000 squares or hexagons, but only between 40 and 400 areas or boxes.[16] Whichever system is chosen, actually producing the game map is simply a matter of scanning the most reliable map of the real battle area, using the *Cyberboard* program to overlay any desired regular grid, digitally tracing the important terrain features such as towns, rivers and coastlines, drawing in any irregular zones, and then deleting the original map to leave just the finished overlay. I will explain this process in more detail in Appendix 4. Since the chosen battle area will rarely form a regular oblong shape, the map can be rotated to fit in the key territory as efficiently as possible, and then any unused corners of the sheet can be used for charts and off-map boxes. However, the map is very likely to evolve as sections are added or removed during the design process, so only draft versions should be used in the first instance.

The great strengths of a regular grid are that it can be generated automatically with no need for arbitrary design choices over the size and shape of individual zones, and that it provides a consistent yardstick for measuring movement distances, troop densities and weapon ranges. Square grids were used in early military and recreational wargames, and have made something of a minor comeback over the past decade.[17] They are easy to draw (still a key consideration when applying grid systems to figure wargames), and they have some benefits in conveying the linear rigidities of pre-modern engagements – I employ them myself for these reasons in my deliberately flexible *Lost Battles* system, which allows users to recreate ancient clashes using anything from pencil and paper or counters on a map to images on a computer screen or miniature figures on a tabletop.[18] However, squares have the major drawbacks that natural terrain (as distinct from city blocks) looks very strange when made to conform to a square grid,

and that the combination of orthogonal and diagonal relationships introduces significant distortions and requires difficult rules choices if units are not to be confined to artificial ‘tramlines’ by ruling out diagonal moves altogether.[19] Hence, the great majority of wargames that employ a regular grid use hexagons instead, especially now that these can be generated automatically by computer graphics programs such as *Cyberboard*.[20]

As Figure 5.1 shows, hexagons adjoin one another only across faces, so there is no ‘diagonal problem’ as with squares, and movement is much more flexible. The winding nature of hex sides also accords much better with the irregular contours of real terrain. However, hexagons are not a panacea, and there are still significant distortions unless one happens to be working ‘with the grain’ of the hex grid. Straight lines of hexes only exist in six directions, and movement paths or lines of units in other directions are uncomfortably jagged, as Figure 5.1 illustrates. One hex-based simulation of urban combat even gave the building corners 60° or 120° rather than 90° angles to allow all the walls to be straight![21] The hex grain problem also obscures some real trade-offs, such as whether Allied bombers in 1943–44 should fly to Berlin directly over heavily defended Holland or via the longer dogleg route across the North Sea and Denmark.[22] As Figure 5.1 shows, Craig Taylor’s excellent simulation *Bomber* (which I discuss much more in Chapter 10) does not capture this particular dilemma at all well, since the distance from East Anglia to Berlin works out at 16 hexes whichever route is taken.[23] These are significant limitations, but, on balance, hexes still cause fewer artificialities than squares, and they are usually the preferred option when using a regular grid.



5.1 The limitations of hexagon grids

The big problem with any regular grid is that, no matter how the underlying map of the actual battle area is shifted around to fit, the real terrain will never coincide exactly with the grid framework, as Figure 5.1 illustrates all too well. The easy response (which is applied to terrain features such as coastlines in too many published wargames) is simply to let the dissonance stand. This does make the map look less artificial, but unless the surface terrain is immaterial (as in an air simulation like that in Figure 5.1), the result is to produce a flood of ambiguities about how the terrain affects the actual game, and to leave some coastal hexes open for land operations despite containing only small slivers of ground amounting to just a few percent of the area of a proper land hex.[24] Hence, my preferred alternative is for the designer to 'rationalise' the real terrain by removing tiny islands and peninsulas and by shifting slightly the course of linear features such as shorelines, rivers, roads and railways so that they conform better to the overlying grid.[25] Dunnigan shows how this process works in his 1992 book, and I will provide my own similar illustration in Chapter 10.[26] Clearly, the finer the resolution of the grid, the less that the real terrain will have to be adjusted to fit, which is why wargames using regular grids typically include so many zones. Ted Raicer's full-size game *Grand Illusion* is unusual in employing just 107 big hexes to portray the Western Front campaign in 1914, and he

leaves the rivers, woods and national borders to follow entirely natural courses in the background while basing the game system itself on more abstract and generic indications of the tractability of each hex and hexside.[27]

The main advantage of using irregular zones is that they avoid this problem altogether, since zone boundaries may be drawn so that they meander naturally along coastlines, rivers and mountain ranges, or in between city blocks in more tactical games.[28] The trouble is that, the more zones one uses, the greater the number of entirely arbitrary lines that must be drawn, rather like imperialist statesmen carving up the map of Africa.[29] Even with relatively few zones, the process is open to very legitimate concerns that too much depends on the designer's whim, and that a different pattern of zones might make the simulation take a very different course.[30] John Butterfield's excellent solo game on the Battle of Britain avoids the problem of arbitrariness by using zones based directly on the RAF's historical fighter sectors, but the irregular size and shape of these sectors creates its own problems, since the rules allow Spitfires from Duxford to patrol over Weymouth 150 miles away but not over Southend just 45 miles away, because the latter is not in an adjacent sector.[31] Designers sometimes choose to employ a mixture of hexagons and areas, typically by using hexagons on land and much bigger areas in the adjoining seas, although this does, of course, cause difficulties with air units that can operate over both environments.[32]

Covering the map with a scattering of separate boxes linked by communication lines might seem at first to be a very different approach than dividing it into a patchwork of irregular areas, but the substantive effect is actually almost identical, since in both cases the result is to create a network of irregular zones, each of which is linked to several neighbouring ones.[33] Boxes can look rather clumsy, and can waste space by leaving large intervening gaps that are usually unavailable for the placement of counters, so I myself tend to prefer continuous patchworks of areas as shown in Chapter 9. Boxes may be more appropriate when the zone system is based more on a 'point-to-point' array of towns or cities linked by key roads, as in the Ardennes in December 1944 when the terrain and weather hindered cross-country movement and gave

crossroads towns like Bastogne a critical importance.[34] Even here, however, one can achieve the same effect using areas, simply by centring each area on such a key town and heavily penalising or perhaps even forbidding movement across any boundaries not crossed by a communication route.[35] The key point is that boxes are usually no less arbitrary than areas, and the more numerous and evenly distributed one's boxes or areas are, the more of a case there is for saving design effort and boosting perceptions of objectivity by employing a regular grid instead.[36]

Whether one uses squares, hexagons, irregular areas or boxes, the effect will be to divide the battle area up into a certain number of distinct zones, with each zone linked to one or more neighbouring zones by a specific boundary (which may be a communication line in the case of boxes). Each zone, and each boundary between two given zones, may be assigned certain properties by the designer so as to reflect the real underlying terrain of the battle area. For example, on a chessboard, there are 64 zones (squares) and 112 boundaries (internal edges) whose properties could all in theory be varied to reflect something other than a flat plain, not to mention the 49 internal corners that could also be tweaked if diagonal moves or attacks are allowed. Figure 5.1 gives a sense of how much scope for tailoring there is in a full-size wargame with hundreds or thousands of zones and with two or three times as many boundaries as it has zones. Even much smaller microgames have plenty of flexibility, as I will illustrate in Part III.

In land wargames, designers must decide which features of the battle area are most relevant militarily, and then reduce them to simplified forms that may be incorporated in their model without undue complication.[37] This is difficult, because in real life such features range seamlessly across the entire spectrum – from tiny orchards to thick forests, from muddy trickles to broad rivers, from isolated farms to crowded cities, from winding paths to multilane highways, from slight rises to precipitous peaks, and so on. The larger the zones, the more abstractly these features will have to be represented, since there will be so much variation within a single zone. Designers must also be guided by military significance – lesser features usually disappear as they do on digital maps the

further the map is zoomed out, but at Waterloo, even small farms like La Haie Sainte played a key role in Wellington's defence, while in the Normandy *bocage*, every slight elevation and church steeple was vital in allowing artillery observers to see beyond the ever present hedgerows.[38]

Linear terrain features normally affect boundaries rather than zones themselves. The usual approach is for watercourses to run along zone boundaries and to make passage across that boundary hard or even impossible for land forces, depending on the width of the obstacle.[39] In cases in which rivers were themselves communication routes through untamed wilderness as in North American conflicts, it may be better for them to run perpendicular rather than parallel to zone boundaries, although they will still remain boundary features (this time making crossing that boundary easier instead of harder).[40] Roads and railways likewise normally run through zones and make movement easier across the successive boundaries they traverse (especially where they cross rivers at bridges or fords), but in the special case of tactical city fighting where the open street was the most dangerous place to be, it may be preferable (as I mentioned) to treat roads more as obstacles and to run zone boundaries along them while basing the zones themselves on the city blocks.[41] I will show in Chapter 11 how one may obtain the best of both worlds by tracing roads through their own strings of dedicated zones between the buildings, at the cost of requiring a very fine map resolution. In larger scale operational or strategic simulations, roads and even railways are often not represented explicitly at all, since they are assumed to be pervasive and to cross every boundary, with any differences in the density of the communication net being captured instead as part of the general distinction between open country and obstructed wilderness.[42]

Non-linear terrain features such as woods, marshes and hills that extend over large areas are sometimes linked to zone boundaries, so as to give a more precise reflection of their actual extent (since boundaries are more numerous than zones themselves).[43] As I will show in Chapter 9, this applies especially to high mountain ranges and to games with very extensive zones.[44] However, in other cases, non-linear terrain is usually

made a feature of zones rather than of the boundaries between them, with entire zones being classified according to their dominant terrain type. Some wargames utilise a wide range of possible terrains such as clear, mixed, broken, rough, marsh, swamp, woods, forest, mountain, town, and city, while other designers prefer to keep things simpler by making fewer subtle differentiations.[45] Larger zones inevitably encompass several real terrain types, and so, in this case, designers often do not even try to shoehorn each zone into a single category, but instead put a numerical terrain modifier in the zone as a composite estimate of how obstructed it is overall.[46] In strategic wargames, certain zones may also be rated for their production value as a source of new recruits, industrial output, or natural resources such as coal or oil.[47] This allows early operational successes to have a direct impact on the balance of power later in the campaign, as I will discuss further in Chapter 10.

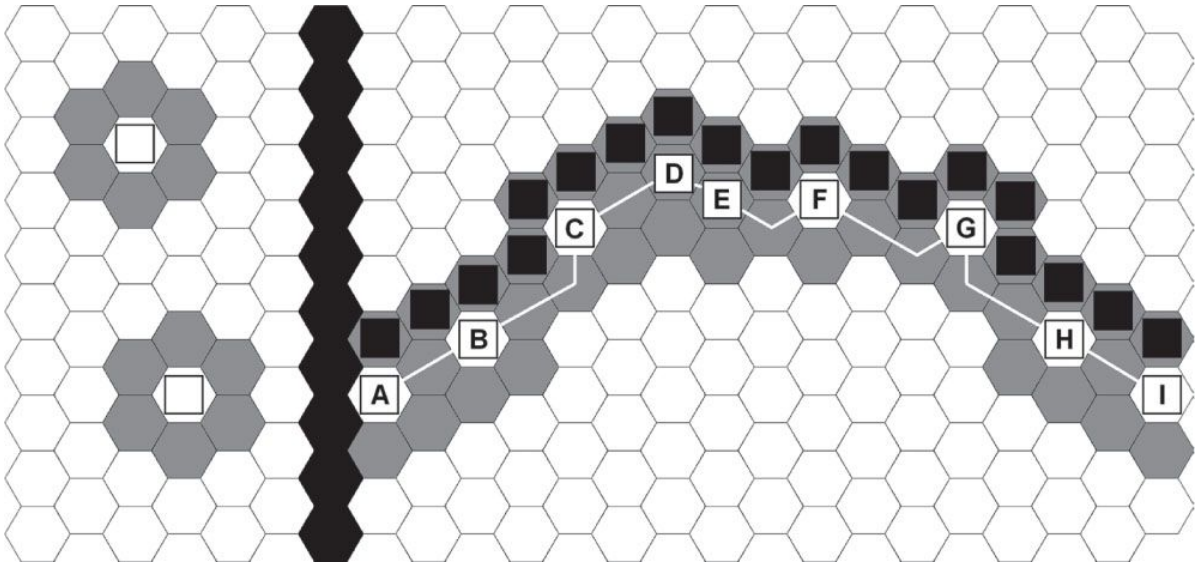
Now, let me pick up my earlier discussion of the double-edged impact of the 'resolution' of a wargame. Having more zones does not in itself make a game take longer to learn and play, but it does usually have a very strong indirect impact in this direction, by increasing the number of separate units that the antagonists require. As I said, if the whole battle area were just one undifferentiated zone, each side would need only one counter to move up and down a strength track to reflect the changing size of its entire forces as they absorbed losses and received reinforcements. Conversely, if the battle area is divided into thousands of tiny hexagons or squares, then it will take hundreds of separate units to track the correct location of each element of the opposing forces and to have any hope of maintaining a continuous front across the width of the map. Each counter takes a finite time to set up, to move, and to employ in combat, and so the more counters there are, the longer and more unplayable the game becomes. The linkage between the number of zones and the number of required counters is weaker in some conflicts such as pre-modern strategic campaigns, where primitive communications forced armies and fleets to move in concentrated clumps, and where it might therefore be possible to make do with only a few counters despite having quite a high resolution map.[48] Usually,

however, the greater the number of zones, the more counters will be needed, and hence the longer and more inaccessible (although more detailed) the simulation.

The problem is greatest in land warfare games where the forces need to maintain continuous fronts across the entire map. Having as many separate units per side as there are initial frontline zones is not remotely enough. For one thing, advances or retreats will stretch the front and losses will reduce the number of units, so in no time at all there will be a gap through which enemy units can pour. This gap is almost entirely an artefact of the game system, since in real life, forces would never willingly guard nine-tenths of a front and leave the other tenth entirely empty – that is purely the result of dividing the front into ten artificial zones and insisting that each of the nine artificial units must occupy one and only one specific zone. A far greater complication (as I will show in Chapter 10) is that, in real land warfare, the thinnest tenable defensive deployment is up to 30 times less dense in terms of troops per mile of front than when forces are concentrated for attack. Hence, a realistic representation of combat along continuous fronts requires several times as many units per side as there are frontline zones, and would produce towering and hopelessly impractical stacks of dozens of unit counters per zone at points of main effort. Ty Bomba's recent redesign of his monster game on Operation Barbarossa in 1941 manages to squeeze the campaign into one standard 22" by 34" map, but it still includes 600 unit counters to cover the 50 or so hexes of front.[49]

Designers have tried various different techniques to reduce this ratio and so to allow engagements to be refought in a manageable time while retaining a reasonably high-resolution map. One approach is simply to split each army into fewer, larger units, but as I have said, this encourages ahistorically evenly spread deployments, and opens small but fatal gaps when unit numbers run out.[50] A second technique is to vary the number of real troops represented by each counter, so that there are enough small units to cover thinly held sections of front while concentrated attacking forces are represented by fewer, larger units so as to reduce the stacking problem I described. This approach helps significantly (as I will show in Chapter 10), but 'typecasting' different forces in this way is rather deterministic, and the more flexible alternative of

allowing any desired unit counter to break down temporarily into several weaker units to hold a wider section of front brings penalties in terms of rules complications and the logistics of swapping counters back and forth.[51] Hence, by far the most important technique that designers have used to reduce the ratio of counters to zones in land simulations is to allow each unit counter to defend more than one zone of front. In tactical wargames, this is achieved through the ability of units to use firepower to engage and suppress enemies several zones away as I will illustrate in Chapter 11, but in hex-based operational and strategic games it is usually handled through the more abstract means of ruling that each unit exerts a 'zone of control' (ZOC) into all six surrounding hexes (even enemy-occupied ones), as shown in Figure 5.2.[52]



5.2 Zones of control as a means of reducing counter requirements

As I will discuss further in Chapter 6, ZOCs may be employed in many different ways to influence movement, combat and supply, but their fundamental use is to allow a single land unit represented by an individual counter to spread out and guard two or even three hexes of front instead of just one.[53] The basic rule needed to underpin this is that units may never enter an enemy occupied hex or move directly from one enemy ZOC hex to another. Figure 5.2 clearly shows how this rule prevents the black units from entering any hex of the white frontline without first destroying or driving back one of the white units in combat. In reality, the white units would not be clumped in the hexes they actually occupy in Figure

5.2 (unless the simulation is on a small enough scale that they can use strongpoint defence tactics and cover the gaps with fire) – they would instead be distributed much more evenly between all the hexes shown as making up the white frontline. ZOCs allow this to be simulated abstractly without needing a counter in every single hex, and they thereby reduce by around half the number of separate units needed to accompany a given hexagon map. The fact that the ZOC rule also prohibits the black units from sliding laterally along the front without first disengaging fully from the line is usually seen as an added bonus, although some designers prefer to negate this consequence by exempting units from the ZOC restriction if they are entering an already friendly-occupied hex or are not penetrating in between two enemy units.[54] Some wargames go even further and allow units (perhaps just armoured units or infiltrating stormtroops or guerrillas) to move through all enemy ZOCs at a reduced movement rate, but this dilutes the main benefit of ZOCs and so significantly increases counter requirements for a given resolution of map.[55] ZOCs are really a hexagon-specific technique, and are very rarely applied in simulations using squares, boxes or areas – they are a major reason why hex-based land wargames can still compete in terms of counter numbers and playability with games using a much smaller number of irregular zones.

Unfortunately, the benefits of ZOCs are accompanied by some significant limitations due to the abstractions involved. Although hexagons allow the terrain in each hex and along each hexside to be quite finely differentiated, ZOC-based systems make combat into a much broader brush phenomenon that has trouble simulating the localised advances and exposed salients of real land operations (as with the highly tangled and indented frontline which developed between Leningrad and Moscow in 1942).[56] In Figure 5.2, the black units cannot penetrate the ‘vacant’ hex between units C and D without attacking and driving back one of those units themselves, while white unit G, although it would actually be deployed mainly in the two ‘vacant’ hexes to its rear, is very vulnerable to being cut off and destroyed since it is completely surrounded by black ZOCs (not shown in the picture) and so would usually be unable to retreat. ZOC dynamics are often hard for

beginners to grasp, and such newcomers do not even get much wider benefit from trying, since the kind of subtle hex geometry involved in creating or cracking a defensive line like that in Figure 5.2 is an artificial phenomenon with very little correspondence to reality.[57]

The most pernicious consequence of the ZOC abstraction is that, when using simple retreat-based combat systems, defending units are actually safer from being surrounded if there are gaps between them (the so-called 'alternate hex defence') than if they form a solid line! From this perspective, unit E in Figure 5.2, far from strengthening unit D as it would in reality, might paradoxically expose it to encirclement if black units force E to retreat and then follow up into its hex (since such advances after combat are usually exempted from the normal ZOC rules that would prevent unit E's hex from being attacked or entered if it were vacant). Essays on wargame tactics lay great stress on the importance of the 'alternate hex defence', but it is purely an artefact of the ZOC system and of the particular way in which this was exploited by certain rules writers in the 1970s to reward players' technical skill in positioning units and in allocating and sequencing attacks.[58] Although ZOCs do offer real benefits by reducing counter requirements and by stopping enemies from literally 'running rings round' artificially static friendly units during the enemy turn, they need to be paired with more subtle combat rules if the inevitable abstractions of the ZOC approach are not to result in unrealistic and 'gamey' tactics that give no worthwhile insights into real military dilemmas.[59]

How many separate unit counters one can afford to have in a wargame, and hence what form and resolution of zone system one can employ on the map, depends ultimately on the length of time available in which to play the game. As I will discuss in Part III, my own long experience of educational wargaming suggests that to complete a game within a two-hour class (even with expert facilitation) requires the simulation to have at the very most 40–50 unit counters for the two sides put together. This might seem paltry compared even to some microgames, let alone compared to full-size wargames with their hundreds of counters, but it is more than the 32 pieces in a game of chess, and in conflict simulations the

majority of counters move and/or fight every turn, rather than just one piece each as in chess. Having at most two dozen unit counters a side means that the battle area needs to be split into no more than around 200 hexes if using ZOCs or 50 zones of whatever kind if not using ZOCs (unless there is no need for a continuous front, in which case many more zones may be practical, as I illustrate in the air games in Chapters 10 and 11). These constraints are by no means enough in themselves to make the game play quickly enough, since that depends just as much on the number of turns and the complexity of the rules, but simulations with more counters will have little chance of being completed in time by non-experts even if the system is very straightforward. Of course, the limited 'resolution' of the wargame does not mean that the physical size of the components need be constrained, and the bigger the map and counters, the better for class use – as shown in the first plates section, I routinely employ 2" square counters on maps three or more feet across.

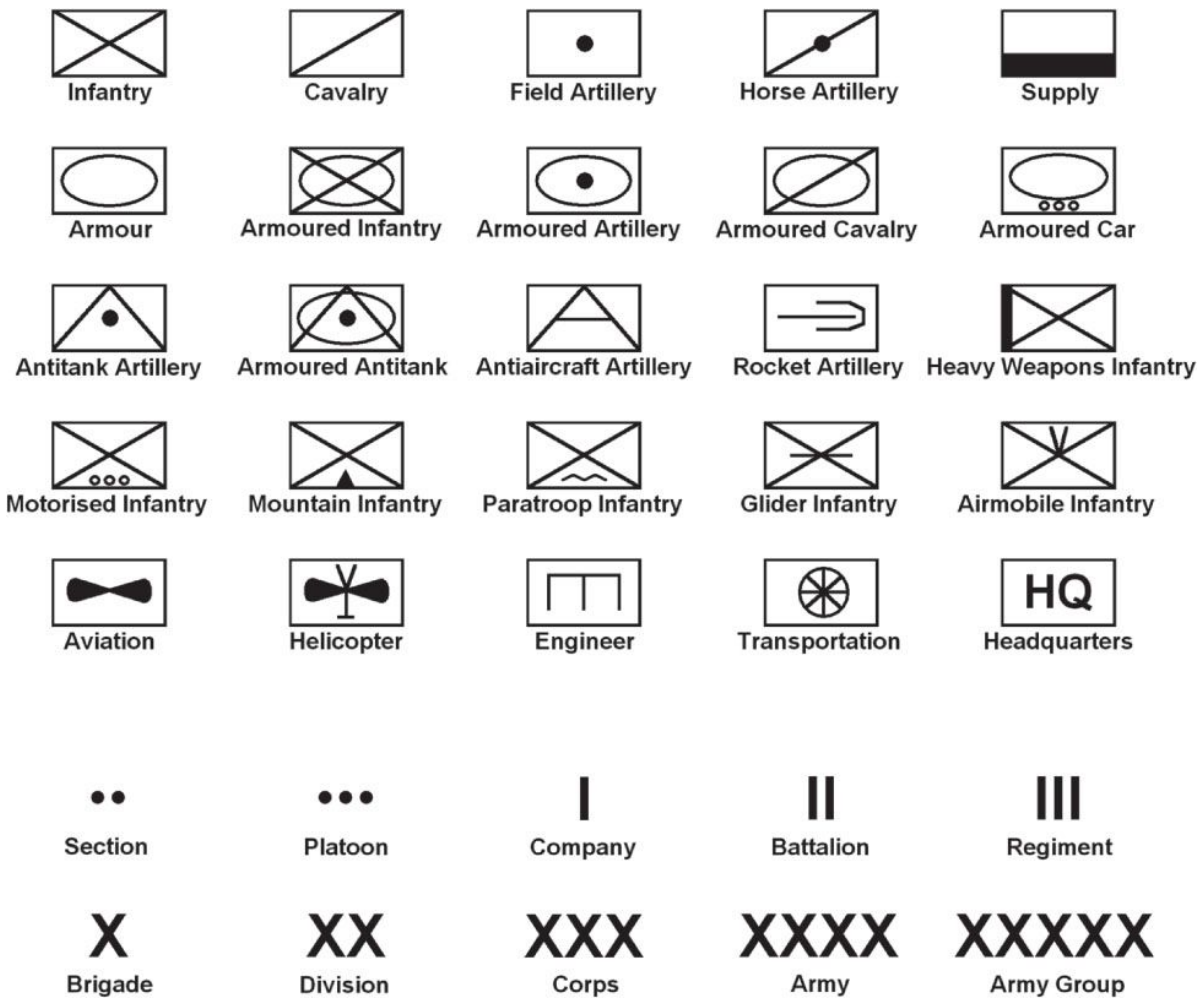
When dividing the opposing military forces among separate counters, the first question is how one should handle the different types of force, such as land, sea and air units, and within that infantry, cavalry and artillery, battleships and destroyers, bombers and fighters, and so on. Sometimes it is appropriate to represent several different unit types directly, but this significantly increases counter requirements and rules complication, so many wargames focus instead on just one or two unit types, while reflecting others only as abstract supporting 'assets' that can provide services such as transport and fire support (perhaps up to a limit represented by moving a single counter down a numerical track each time that asset is employed, or perhaps simply by boosting the overall movement, combat or supply capabilities of one side to reflect pervasive factors such as air or naval superiority).[60] The next question is whether each counter should represent just a generic group of forces of the selected type, or a specific real military unit. The latter approach makes the wargame look much more of a simulation and less of an abstract 'game', but it does bring significant complications. Real military units often change their strength, composition and even nomenclature over the course of an extended campaign, so for example the German 9th Army had far more tanks than the neighbouring 2nd Panzer Army at the time

of the Kursk offensive in July 1943, while the individually titled Soviet ‘fronts’ were all redesignated later that year as numbered Baltic, Belorussian or Ukrainian Fronts.[61] Hence, it is sometimes better to treat counters as generic collections of ‘strength points’ than to become too preoccupied with the changing military ‘wrappers’ within which these forces are marshalled.[62]

If representing real military formations is practical, the key is to select a level of unit organisation that fits with the resolution of the map and the number of counters desired. For example, Operation Market Garden in September 1944 may be simulated at the division level with around a dozen unit counters, at the brigade/regimental level with around 50 unit counters, at the battalion level with around 200 unit counters, or at the company level with around 800 unit counters.[63] Naval or air simulations may be scaled in a similar way, with counters representing anything from individual ships or planes to entire fleets or air groups.[64] As I mentioned, it is often preferable to adopt a hybrid approach, with some force elements that are of high quality or that operated in an especially dispersed fashion represented at one organisational level, while other forces that fought in more concentrated groups are compressed into larger units based on the next higher organisational level.[65] Real forces often include smaller ‘independent’ units (such as German Tiger tank battalions or British armoured brigades) that sit outside neat organisational hierarchies, and such units must either be represented separately or included abstractly within the larger formations’ strength.[66] It is sometimes appropriate to model the two opposing sides at different organisational levels, especially where significant asymmetries exist between the two systems.[67] I will illustrate all these issues in more detail in Chapters 10 and 11.

Graphic design of the map and counters of a wargame is an art in itself, and there are several professional artists who make their living in this way.[68] However, with modern computer graphics programs, most people can create a perfectly workmanlike standard of artwork themselves, as my own experience and that of my students shows. The key graphical requirement for effective use of a simulation is clarity, and here, overly ‘naturalistic’ artwork and superfluous artistic flourishes can actually be

counterproductive, since they may make it difficult for the players to discern exactly what the game terrain and unit characteristics are.[69] Covering each zone and each counter entirely in a single solid colour is quite enough for clarity, and the main thing is to ensure that the various colours used for differing terrain, opposing units, and overlying text and symbols contrast sufficiently with one another that everything may be distinguished clearly.[70] With only a little extra effort, one can produce rivers that meander naturally along zone boundaries, and coastlines, forests and hills with winding edges that fit neatly within groups of hexes, still making it perfectly clear what the dominant terrain of each individual hex is.[71] Figure 5.3 sets out some of the standard NATO symbols for unit type and size, as employed on the counters of most published wargames, but many designers prefer to include silhouettes or even full colour pictures of the relevant troops or military equipment such as tanks, planes and ships.[72] The text figures and colour plates in this work and in my previous book (all produced by me) illustrate what non-experts can do, and Appendix 4 gives practical hints as to how readers may create similar or better artwork of their own.



5.3 Some standard symbols for unit type and size

Designing the components of a wargame is not an independent process, and it must proceed in parallel with the design of the rules system and the game scenario. Even during playtesting, designers often choose to add, remove or modify certain unit counters or map areas in order to improve their simulation. Especially prone to adjustment are the movement and combat values of the units, which I discuss in Chapter 6, and which are usually recorded in large numbers on the bottom of each unit counter beneath the unit type symbol. (As I will illustrate in Chapter 10, unit size is traditionally shown at the top of each counter, while the identity of the real formation represented is shown to the side of the unit type symbol, sometimes with the unit's own identity to the left of the symbol and the higher formation of which it forms part indicated to the right of the symbol. Higher formations may be highlighted further, perhaps by a distinctive background colour within the unit type symbol itself, if the rules encourage units to be used in groups

corresponding to the real command hierarchies, as I illustrate in Chapter 11.) Some designers prefer to keep their draft components on the computer as long as possible to facilitate easy amendment, while others like to experiment with hard copies, perhaps using pencil at first so that changes may be made. In my conflict simulation MA course, I insist that hard copies are used for team playtests, since they are easier for groups to use, and since they reveal problems of contrast and readability or counter size and handling that may not be so apparent on the computer screen. Component design involves juggling many different considerations, and it is almost impossible to get it right first time – one must instead be prepared for a long process of experimentation, trial and error before an optimal solution is reached.

6

Modelling conflict dynamics

Like the board and pieces in chess, the map and counters in a wargame are useless without clear rules to specify how players may use the components to contend for victory. It is here where wargame design departs most clearly from the process of simply drawing a succession of battle maps to illustrate the actual course of an engagement, as in traditional books on warfare.[1] However, the two activities are not utterly dissimilar, and (as I said in Chapter 4), 'storyboarding' a real past battle as a succession of overhead maps, perhaps using the draft map and counters from the simulation itself, is a very useful way of starting the development of the rules. The central characteristic of the storyboard approach is that it divides the engagement into successive slices of time, and provides a 'snapshot' of the position of the forces during each key phase. In exactly the same way, manual wargame designers usually specify that the battle will proceed through a series of successive 'turns', each representing a given period of time within the overall duration of the conflict. Designers then construct a 'sequence of play' consisting of several phases within each of which specified activities may take place, and at the conclusion of which a new turn begins and another full iteration of the sequence of play occurs. Once certain conditions are fulfilled or a specified number of turns have been played, the wargame ends, and victory is assessed.

Just like the decisions over the division of the map into zones and the splitting of the contending forces into distinct units, the division of the game into turns depends on several intertwined and conflicting considerations. One key variable is the resolution of the simulation, since the more turns there are, and the more involved the sequence of play within each turn, the longer the game will take to play. My own experience suggests that around ten turns is

the practical limit for completing a simple microgame within a two-hour class, unless the activities within each turn are unusually limited and streamlined as I discuss in Chapters 9 and 11. Some full-size wargames contain so many counters and have such involved sequences of play that users would be hard-pressed to complete even a single turn in this same period (and some strategic games do indeed include small 'battle scenarios' lasting only a single turn or even less).[2] Having fewer, longer turns allows units to move through more zones per turn, and so allows greater differentiation between unit speeds given that moves are normally restricted to covering a whole number of zones. That said, the more turns there are in the game, and the more involved the sequence of play within each turn, the more scope there is for interactivity and for players to react to enemy actions and to unexpected threats and opportunities that arise as a consequence of earlier events.

The simplest way of splitting a wargame into turns is to divide the total duration of the engagement by the number of turns desired, to produce a standard duration for each turn. Hence, a one-day battle might have turns representing an hour each, while a three-month campaign might be fought in weekly turns. As with a regular map grid, the advantage of using turns of a common length is that it requires fewer subjective judgements and provides standardised intervals of time for ongoing activities such as movement and production. The trouble with using equal length turns is that it encourages players to engage in roughly the same amount of activity in each successive turn, whereas real conflicts often proceeded in fits and starts, with long periods of waiting and preparation punctuated by brief but intense flurries of manoeuvre and combat.[3] The North African campaign in World War Two is the classic illustration of this 'stop–go' dynamic, but similar characteristics may be observed in many other conflicts, as reflected in the old adage that war consists of long intervals of boredom punctuated by brief moments of sheer terror.[4]

One way of responding to this variability is simply to focus the wargame on a single intense period of combat, while leaving the quieter periods before and after entirely outside the scope of the simulation. A second response is to take precisely the opposite

approach, by making each turn long enough to include both a flurry of campaigning and a longer interval of passivity (for instance by simulating World War Two using seasonal or biannual rather than monthly turns).[5] A third response is to have some turns represent a much longer period than others, for instance during rainstorms or nighttime in tactical games or during snowy or muddy weather in strategic games.[6] This saves playing time and reduces the need for special rules to simulate the slowing down of operations in such conditions, but it is rather abstract and deterministic, and it captures only part of the reason for the highly variable intensity of real campaigns. A fourth response is to simulate the reasons for the variability more directly, using rules for supply, fatigue and command to limit the number of turns on which units may move and fight effectively. This typically involves quantifying supply or command in terms of an overall stock of 'points' that are accumulated slowly during 'strategic turns' when both sides remain passive and then expended during a succession of shorter 'action impulses' when one side chooses to launch an active offensive.[7] I will return to this topic when I discuss logistics at the end of the chapter.

The most basic activity that units need to be able to undertake in a turn is to move across the map. This is easiest to systematise in air and naval simulations, because of the relative uniformity of the medium traversed and because ships and planes tend to proceed at fairly constant 'cruising speeds' (unless dependent on the wind). Hence, one can work out maximum move distances in zones per turn using the straightforward proportionality techniques set out in Appendix 3 and illustrated in Chapters 10 and 11. Land movement is much harder to standardise, because the speed of particular units varies so much with the terrain and other conditions in effect. Only for infantry moving on foot is the maximum sustainable march rate of a few miles per hour much help as a yardstick, and even this tends to exaggerate the capabilities of large forces moving in long and unwieldy columns – Engels calculates from the ancient records that the average speed of Alexander the Great's army was just thirteen miles per day, although small light detachments could move three times as fast.[8] Motor vehicles are capable of reaching dozens of miles per hour in

ideal conditions, but here the gulf between theory and practice becomes much greater when considering the overall speeds of entire motorised formations. Were one to base movement allowances purely on theoretical maximum speeds, then motorised units should outpace foot troops by an order of magnitude, but Bellamy cites Israeli studies that suggest: '[T]he Mongols, with an average rate of advance of 27 kilometres per day in battle conditions were the fastest-moving army in history, outstripping Rommel and the German armies in France, Poland and Russia during World War Two.'[9] Hence, it is vital to place at least as much reliance on 'storyboarding' and on real data from comparable campaigns as on theoretical performance when assigning movement capabilities to land units.

Since real land movement rates are so variable, the usual practice of giving each unit type a single standard move allowance per turn (typically recorded by a number on the bottom right of the unit counter) is agreeably simple but of rather dubious validity. On the one hand, basing standardised move allowances on the lowest common denominator risks repeating the error made by one of my MA students when she limited movement to the historical advance rate during the campaign she was modelling, hence preventing faster progress even if the enemy forces left part of the front entirely ungarrisoned! On the other hand, basing move allowances on the fastest recorded dash by an individual unit risks having every unit race around routinely at that speed every turn. In children's boardgames, move distances are varied by dicing each turn to find the number of spaces moved by a given piece, but such randomisation is not really appropriate for wargames since it makes the system rather too dependent on blind chance, and since dicing every turn for every moving counter would unacceptably increase playing time. Hence, designers have sought more controlled ways of varying the distances land units move over. One is to have a 'forced march' option, which allows selected units to move further than normal, but at an increasing risk of becoming disrupted through their exertions.[10] Another approach is to allow only a certain number of each side's units to be moved at all each turn (on the grounds of limited supplies or command capacity).[11] As in chess, this tends to mean that certain units are

moved repeatedly whereas others are left in place for turns on end, hence both reducing playing time and mirroring the variability of real movement rates. The two approaches may be combined by allowing selected units to move particularly fast but at a very high cost in scarce command points, as in my own *Lost Battles* system.[12] A simple and sadly underused means of dissuading players from moving all their units every turn in modern land wargames is to rule that individual units may either move or dig in each turn – this gives a real incentive to keep defending units in place in order not to lose their entrenched status.[13]

By far the most common way in which designers vary land movement rates is to express the movement allowance of each unit in points rather than zones, and then to vary the cost of entering each zone depending on the terrain (and sometimes also the weather and unit type), as recorded on a 'terrain effects chart'. For example, in David Cook's detailed simulation of the battle for Moscow in 1941–42, it costs a German panzer unit two of its fifteen movement points to enter a woods hex in dry weather, while it costs an infantry unit one of its eight movement points to enter a clear hex in frozen conditions or three of its four movement points to enter the same hex in deep snow (since movement allowances are halved in mud or deep snow in addition to the increased costs per hex).[14] Obstacles such as rivers running along zone boundaries typically add to the cost of entering the zone concerned, while roads across boundaries usually allow entry at a discount rate (especially for motorised units). There is clearly plenty of room for flexibility and subjective judgement as to what the effective movement rate of different unit types should be in different terrain and weather conditions, and it is here where playtesting comes into its own as a means of gauging which of the multitude of possible combinations comes closest to simulating the observed reality. From the perspective of playability, it is, of course, best to keep things as simple as possible so that players may move units quickly without constant reference to the rules and charts, and I will illustrate such simple land movement systems in Part III.

The other main factor that designers use to vary land movement capabilities is the proximity of the enemy. Most

designers rule that units must stop when they move into contact with opposing forces, even if they have movement points remaining. In Chapter 5, I discussed how ZOCs can prevent units from moving through or sliding along an enemy line, but many wargames go further and either constrain or prohibit altogether the voluntary withdrawal of units from enemy ZOCs, thereby pinning those units in place as Napoleon tried to do to opposing armies before launching his final battle-winning attack.[15] Conversely, some simulations increase the movement potential of land units if they remain a certain distance away from the enemy throughout their movement (and hence can spend the entire turn moving without being drawn into combat).[16] Other wargames achieve similar effects by allowing units to switch between different deployment 'modes' – in road column mode, units may move swiftly but are ineffective in combat, while in battle mode the reverse is the case.[17] Rules often seek to reflect the 'traffic jam' effect by prohibiting units in road column from entering (or sometimes even moving adjacent to) zones containing other friendly units.[18] In many wargames, units up to a certain capacity limit may move very long (often unlimited) distances by rail, sea or air transport, and there are even provisions for the destruction and repair of railroads and the impact of different gauges as in the Eastern Front campaigns during the two world wars.[19] The potential subtleties are almost endless, and the key (as I discussed in Chapter 2) is to focus only on those details that matter most while keeping the overall movement system as simple and playable as possible.

Besides movement, the other essential activity that units need to be able to undertake in every single wargame is combat with opposing units. In chess, combat is significantly more straightforward than movement, since pieces automatically destroy enemy pieces (regardless of the respective piece types) simply by ending their move in the same square. However, as I discussed in Chapter 1, real combat is probably the most complex element in the whole of warfare, since it involves a multiplicity of physical and psychological variables that make it hard to encompass using any analytical or modelling technique, however sophisticated. Wargame designers must do their best to identify the key variables

and to structure combat outcomes accordingly, without making their systems unplayably complex and time consuming.

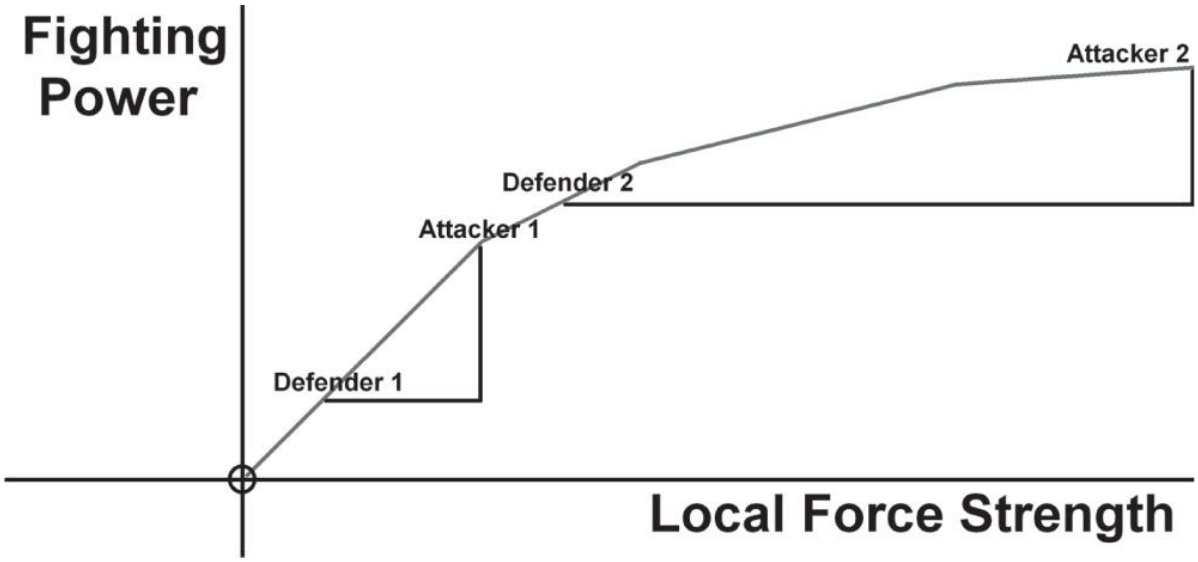
The first question is what spatial relationship between opposing units allows them to engage in combat with one another. The simplest system is one in which opposing units must occupy the same zone in order to fight. This system is most commonly employed in games using large irregular zones and in operational or strategic simulations of conflicts without continuous fronts, in which weapon ranges are small compared to the scale distance across each zone. Wargames of naval or air campaigns or of pre-twentieth-century land campaigns fit this pattern, since the forces tend to operate in concentrated clumps that range freely across the entire theatre, occasionally running into one another, triggering an intense clash.[20] However, in more tactical simulations, some weapons (especially heavy-calibre guns) will be capable of engaging opponents from one or more zones away and not just from the same zone. A more pervasive problem is that, in engagements in which continuous fronts are formed (which has been the case since ancient times within battles themselves), same-zone combat makes it hard to represent flank attacks and to record which neighbouring zones are behind which side's line.[21] Hence, conflicts involving continuous battle lines spanning multiple zones are much more commonly represented by prohibiting movement into enemy-occupied zones and by allowing units to attack into adjacent enemy zones as illustrated in Figure 5.2, advancing into the zones only if the defenders are destroyed or driven back.[22] Some wargames (especially tactical ones and those employing large irregular zones) adopt a more complex hybrid system in which battle lines are formed in separate zones but in which opposing units may also occupy the same zone for shorter or longer periods during 'close assault' combat.[23]

Basing combat on attacks from one zone into another has the advantages that it reduces counter congestion, makes frontlines more distinct, and allows boundary terrain such as rivers to impede either side's attacks, but it has several disadvantages of its own. First, it makes it much less clear than in same-zone combat which units are engaging which enemies and it necessitates quite involved rules about attacks from or against multiple units or

zones. (The usual approach is to rule that each zone may only be attacked once per turn, with all attacking units from whatever direction combining their strength against the total resistance of all the defending units in the zone, but that different attacking units in a single zone may attack different enemy zones in separate combats as long as each unit launches only one attack per turn.)[24] Second, in tactical simulations in which direct-fire attacks are allowed from beyond the immediately adjacent zones, there need to be additional complex rules to determine whether a line of sight exists or whether visibility is blocked by intervening terrain or units, as I illustrate in Chapter 11.[25] Third, having units confront one another from different zones means that curving fronts can vary greatly in length between the two opposing sides. This effect is most extreme in the case of a surrounded force crammed into a single hex, since the encircling enemies must guard all six adjacent hexes to prevent a breakout. Although the frontline is six hexsides long in both cases, one antagonist must guard each hexside separately (which is particularly problematic if not using ZOCs), while the surrounded force has the flexibility to exploit interior lines and to focus all its strength in any desired direction.[26]

Which side benefits most from this phenomenon depends on how the rules handle two other crucial elements of combat – force density and automaticity. ‘Force to space ratios’ are a key variable in real warfare, given the difficult trade-off between massing forces to achieve local superiority and dispersing them to reduce their vulnerability and to minimise wastage and overcrowding, so modelling the impact of different force densities is very important for accurate simulation.[27] Figure 6.1 shows how cramming more and more forces into a given area has diminishing returns in terms of overall fighting power, because the extra forces create a more concentrated target and find it hard to bring all their own weapons to bear. The two triangles in Figure 6.1 illustrate combats at high and low force densities. Although the attackers enjoy a canonical 3:1 numerical superiority in both cases, this constant force ratio advantage gives a much lower proportional advantage in terms of fighting power when force to space ratios are higher on both sides. Wargames usually reflect this phenomenon by limiting the size of force that can occupy or engage in combat in a given zone,

thereby restricting additional forces to the much less effective role of waiting in the rear to replace losses without being able to influence the immediate combat itself.[28]



6.1 Diminishing returns from higher force densities

Simple wargames with a fine hexagon or square grid sometimes allow only a single unit to occupy each zone, as in chess.[29] Although this reduces rules complications and makes it easier for players to see all their units, it is usually justified only in tactical simulations like those in Chapter 11, where the grid is of such a fine resolution that the troops and weapons really do fill entire zones, to the point where individual ships may need to occupy two hexes lengthwise rather than just one.[30] As I discuss in Chapters 5, 10 and 11, there is normally a much greater range of variation between the thinnest tenable and the densest practical deployment of forces within a given area, so restrictions on the stacking of multiple units in the same zone should generally be fairly liberal and should focus more on the increased vulnerability of crowded forces to bombardment or starvation than on the usual draconian provision that units in excess of the stacking limit are subject to instant and automatic elimination.[31] Allowing higher stacking of units in each zone makes achieving force superiority less a matter of occupying more hexes within an adjacent zone combat system, and so gives less of an advantage to the side operating on exterior lines. However, as I discuss in Chapter 10, more liberal stacking needs to be accompanied by restrictions on how many units may

fight effectively in any given combat, and these restrictions should ideally be based on boundaries rather than zones themselves, to prevent forces massed in a projecting salient from concentrating their full weight in an attack across a single boundary against just one adjacent zone of their choice.[32]

This leads on to the other key decision for wargame designers, namely whether combat between nearby opposing forces should be automatic or discretionary. Some wargames insist that proximity to the enemy is an inherently unstable state requiring a continuing succession of attacks on all nearby enemy units by each side in turn. This applies especially to the simple SPI 'quad' games of the 1970s, whose 'locking active ZOCs' prevented units from withdrawing voluntarily once engaged and meant that combat gained a momentum of its own as the compulsory attacks surged back and forth.[33] Such automaticity has the merit of forcing units to confront all nearby threats and of reflecting patterns such as Stalin's insistence on repeated attacks in 1941 despite the losses suffered by Soviet forces, but it also reduces player discretion, lengthens playing time because of the sheer number of combats to be resolved each turn, and diminishes the defensive value of terrain such as river lines because units are forced to attack as much as defend.[34] Tactical wargames often make attacks by all engaged units effectively automatic by structuring combat as a series of volleys of fire by each side – as I will show in Chapter 11, unless ammunition levels are modelled properly, there is nothing to lose by firing, and the choice becomes which target to fire at each turn rather than whether to fire at all.[35] However, most wargames instead leave it up to the players whether to launch attacks, and they make the resulting combats two-sided affairs that can hurt the attackers as well as the defenders. The result is that some parts of the simulated front remain quiet for months on end (as often happened in reality even when opposing forces were as close together as in the trenches of World War One) and that combats flare up only where one side or the other sees an opportunity to gain more than it might lose.[36] This more discretionary approach does have the drawback that it can encourage 'turn-by-turn opportunism' in which players alternate in seeking the chance to gang up on certain enemy units while ignoring more powerful ones,

but, on balance, it usually offers a better simulation of the sporadic and episodic rather than continuous nature of real combat.

Chess has only one combat outcome (the complete removal of one side's piece), but wargame designers may choose from a much broader range of results as they seek to mirror the complexities of actual armed conflict. There are basically four types of outcome for any simulated combat. First, the action may have no significant effect on the forces engaged. Second, one or both sides' units may be forced to retreat a smaller or larger distance from their existing positions, and the enemy may be able to follow up by advancing into the vacated space. Third, one or both sides' units may suffer some form of disruption that reduces their future movement and/or combat capabilities, and from which they may be able to recover at some future time. Fourth, one or both sides' units may sustain permanent losses that diminish their fighting strength, and that may reach as far as the complete elimination of some or all of the units concerned. By choosing among these four types of outcome, mixing and matching them, and exploiting the many possible variations within each, designers have enormous flexibility to tailor combat results to deliver the effects desired.

Which combat outcomes deserve greatest emphasis depends very much on the nature of the conflict being simulated.[37] In air and naval warfare, results will usually take the form of physical damage to the contending craft that progressively reduces their movement and combat potential until they are shot down or sunk.[38] In land attacks against forces employing mobile defence or hit-and-run tactics, retreats will be the order of the day.[39] In artillery or machine gun bombardments of entrenched troops or in pre-gunpowder land battles in which casualties seem to have been remarkably light until one side fled and exposed itself to one-sided slaughter in the pursuit, disruption is the most appropriate result, since the affected forces could recover almost completely unless they were physically overrun while in their temporarily suppressed and demoralised state.[40] As I mentioned in Chapter 5, some simple wargames since the 1970s have used a fairly 'bloodless' combat system in which the results are mostly retreats, and in which the main way of inflicting actual losses is to cut off the enemy's retreat by means of advances in earlier combats, but this

system encourages artificialities such as the ‘alternate hex defence’ and is of dubious validity for the historically rather attritional nineteenth- and twentieth-century land battles for which it was mainly employed.[41] Much more successful have been systems that give the players added discretion over combat outcomes, for example by allowing the attacker to choose between a cautious and a costlier all-out approach, or by expressing combat results as numbers and then giving players the choice of whether to retreat that many zones, to stay in place and absorb that many losses, or some combination of the two.[42] I will illustrate such a discretionary system in Chapter 10.

One major reason why retreat and elimination results have been popular with designers of simple wargames is that they can be applied merely by moving the affected counters across the map or removing them from play altogether.[43] By contrast, disruptions and fractional loss or damage results require that the unit counter be amended in some way to record its more fragile status. One invaluable attribute of cardboard counters is that they can have two printed sides, and so the reverse side may be used to display the unit in a disrupted state or having suffered permanent but not yet terminal damage. However, flipping the counter over only allows two different states to be shown, and the reverse side may already be in demand to denote an alternative status such as activated, fired, entrenched, or in column formation.[44] Recording anything beyond a single pair of alternative unit conditions requires the use of additional counters. The simplest approach is to have a spare counter off to one side that may be used to replace the existing unit when required – this device is quite often used to give certain resilient units four ‘steps’ of strength rather than just two, with one counter showing the unit with four and three steps and the replacement counter showing it with two and one steps.[45] Simultaneously using two or more counters offers even more flexibility, since the additional counters may be used to show even finer gradations of unit strength or status, either by selecting appropriately numbered strength markers from a pool or by having one or more off-map tracks along which are moved counters corresponding to each specific unit (as illustrated in Chapter 9).[46] The drawback of such measures is, of course, that they compound

stacking problems and increase playing time by multiplying the number of counters in use and making it very hard for players to see at a glance the condition of their units.[47] This is yet another area where detail and resolution may need to be sacrificed for playability, as I illustrate in Chapter 11.

Already discussed in Chapter 1 is the wide range of factors that influence combat and how analysts such as Lanchester, Dupuy and Biddle have tried to capture them within mathematical formulae.[48] Wargame designers need to attempt similar feats, albeit on a more impressionistic basis, if they are to estimate the likely outcome of any given attack. The simplest approach is to award each unit a numerical 'combat strength' as a composite judgement of its numbers and quality, and to record this figure on the bottom left of the unit counter. The combined strength of all the units attacking a given target can then be totalled, and modified if necessary to take account of other factors such as terrain, weather or leadership – for instance, units attacking across a river might have their effective strength halved. It may then be possible to devise a simple rule such as that one hit is inflicted for every six points attacking, and that the enemy inflict one hit in return for every six points in the zone attacked. Such a rule would obviously make the outcome of every attack unrealistically predictable in advance, so it is here where almost all designers introduce a degree of random variation using die rolls, both to increase uncertainty and to smooth what would otherwise be abrupt thresholds in the damage inflicted. For example, the same average damage as in the simple rule I just stated would result from rolling one die for each group of five strength points and one further die for any remaining points, with one hit being inflicted for every die roll which does not exceed the size of the group concerned – I use exactly such a system in the *Roma Invicta?* simulation detailed in Chapter 9. As I have already mentioned, this random element is one of the most controversial and misunderstood aspects of wargames, and I will discuss the issue fully in Chapter 8 and in Appendix 3.

The drawbacks of a simple combat resolution system such as the one I have just outlined are that its outcomes are rather unidimensional, it can involve lots of die rolling and it often embodies the same unrealistic assumptions as in Lanchester's

flawed model (which the system here would mirror faithfully if continued over several turns of fighting).[49] Hence, most wargame designers instead construct one or more ‘combat results tables’ (CRTs) to streamline resolution procedures and to give them the flexibility to tailor and vary combat outcomes as desired.[50] Virtually all such tables consist of a series of columns, each one corresponding to a different set of circumstances that are arrayed in a spectrum running from the least favourable to the most favourable to the attacking side. Each column contains a range of plausible combat outcomes for the circumstances concerned and down the left-hand side of the table is listed a full spread of possible die or dice rolls. Once a given attack has been declared, the attacking player works out which column corresponds to the overall circumstances of that attack, rolls the die or dice, and cross-references the column with the die or dice roll to read off the specific combat outcome that will take effect in this case. Factors such as terrain can be incorporated by modifying effective combat strengths as I have already described, but they can also be reflected by shifting the column used in either direction or by adjusting the die or dice roll up or down, hence giving further flexibility for designers to employ.

Within this broad pattern, there are three basic types of CRT, each with its own strengths and weaknesses. The first type is a unilateral table used by each side in turn, in which the columns correspond to increasing absolute strength of the firing side.[51] This has the merit that larger forces can be made to inflict higher losses than smaller ones, but the disadvantage that it requires both sides to fire separately instead of in one combined resolution process. The second type of CRT is a ratio table, in which the columns correspond to increasing ratios of superiority between the total attacking and defending combat strength.[52] This has the advantage that ratios are often the best measure of the force balance (as shown by the widespread idea that attackers need at least a 3:1 superiority to prevail), but it masks absolute force sizes and means that small superiorities are useless unless they reach an artificial threshold such as 2:1.[53] The third type of CRT is a differential table, in which the columns correspond to the difference between the attacking and defending strength.[54] This is easier to

calculate than strength ratios and allows small superiorities to be recognised, but it has the major disadvantage that a battle between sixteen points and eleven points produces the same +5 differential as a battle between six points and one point, even though the force ratios are radically different in the two cases. As Figure 6.1 shows, higher force densities should actually benefit the defenders even at consistent force ratios, whereas differential CRTs unfortunately have precisely the opposite effect. CRTs are by no means essential, and many wargame designers including myself build combat systems that do without them, but they do sometimes offer valuable benefits, as I will illustrate in Chapter 10 when I describe the construction of one of my own rare CRTs.[55]

Capturing the entire net fighting value of a unit within a single figure for ‘combat strength’ is, of course, much easier said than done and designers often prefer to adopt a more nuanced and less reductionist approach. One common technique is to give units separate attack and defence strengths, with the relationship between these two ratings highlighting the tactical differences between tanks, on the one hand, and entrenched infantry, on the other.[56] Another approach is to disaggregate the constituent elements of unit fighting power, for example, by focusing the strength rating more on troop numbers while representing qualitative issues such as training, equipment or morale by separate ratings that can produce column shifts or die roll modifiers based on the relative quality of the engaged forces.[57] Unit counters also often specify the range in zones over which units can attack the opponent, allowing certain units such as artillery batteries, battleships and air groups to strike from outside enemy range and to support other units across a wide arc of front.[58] Further rules differentiations based on varying unit types can reflect the ‘scissors-paper-stone’ relationships frequently found in the interaction of different combat arms, and can reward effective use of combined arms tactics.[59] As usual, the downside of such detail is increasing complexity, with counters becoming crowded with multiple ratings and with combats taking longer and longer to resolve, so the key is to focus on only those aspects that mattered most in the specific conflict concerned.[60]

As mentioned at the start of the chapter, each turn usually proceeds through successive phases as laid down in a standardised ‘sequence of play’. One function of the sequence of play is to structure interaction between the opposing sides, and I will discuss this further in Chapter 7, but the other main function of the play sequence is to provide a framework for movement and combat. The central problem is that each turn represents a given slice of time during which each unit could in principle engage in various possible combinations of movement and fighting, with different units doing different things at the same instant. Computer simulations like those produced by Panther Games can handle this diversity because they run continuously and do not rely on artificialities like turns, but manual wargames must be operated by the players themselves and so require a much more definite structure and sequence so that actions do not become hopelessly confused.[61] Designers have tried a wide variety of approaches to mitigate this problem, but no solution has achieved the elusive ideal of combining simplicity with realistic flexibility. The most ambitious and complex attempt to square the circle was in Australian designer Dave O’Connor’s 1985 Eastern Front simulation *Trial of Strength*, in which he divided each ten-day turn into daily segments and required numbered markers to be placed on units to show how many days of movement and fighting they had undertaken so far, so that the actions of different units could be coordinated.[62] It is no accident that O’Connor and his company (Panther Games) later embraced the growing capabilities of the PC to overcome these complexities, and so have now become the leading exponents of computer wargame design.

Early manual wargames opted for a much simpler two-phase approach in which each player moved all his or her units as desired, and then launched a series of attacks on nearby enemies.[63] This straightforward ‘move–fight’ sequence has remained dominant ever since, especially in simpler wargames.[64] In naval and air games it is reasonably effective, because the craft involved move continuously throughout the turn, whether firing or not.[65] In land games, the move–fight sequence is also fairly acceptable, because it allows players to move units forward to attack selected points of weakness, and because units that spend

the entire turn moving rather than fighting may easily be awarded a compensatory movement bonus as I mentioned earlier.[66] The move–fight sequence is less appropriate for land units that start the turn already in a position to attack, since they gain no benefit from their forfeited movement, and still cannot exploit any breakthrough they might make except through the standard provision for a short advance after combat. Such units would be much better off with a reversed sequence of 'fight–move', but as a general rule this sequence is much more problematic since it prevents units from attacking enemies who are just one zone outside their range at the start of the turn, and hence it may allow inferior forces to withdraw their line one zone per turn and so avoid enemy attacks altogether.[67] As I will show in Chapters 7 and 10, the fight–move sequence does have some merit in simulating more ponderous forces which favour set-piece offensives rather than swirling manoeuvre warfare, and some recent wargames thus employ asymmetric sequences for the two sides or allow one or both players to choose each turn whether they will use move–fight or fight–move (or sometimes even move–move or fight–fight).[68] However, even with this degree of flexibility, there are bound to be some units that are ill positioned to benefit from a chosen phase order applied *en bloc* to the army as a whole.

In 1971, Dunnigan's game *Barbarossa* incorporated two innovations that sought to address the deficiencies of the simple move–fight sequence in modern land simulations.[69] One was to allow powerful groups of units to 'overrun' weak blocking units during the movement phase rather than being held up until the combat phase, and the other was to add a third 'exploitation' phase after the combat phase, during which armoured units could move again and so exploit breakthroughs and surround enemy forces. Variants and developments of this three-phase system and of the opportunity for 'mobile assaults' during movement phases have since become fairly standard as a way of simulating fast moving armoured warfare.[70] Meanwhile, designers seeking to simulate ancient wars moved in the opposite direction, and instead of proliferating movement and combat phases they merged them into a single unified 'campaign phase', during which each individual army and fleet could expend points to move and fight in any

desired order.[71] In the 1980s, designers such as Balkoski, Ritchie and O'Connor tried to apply this last approach of a unified and flexible 'operations phase' to twentieth-century land campaigns, but the problem they faced was that (unlike ancient forces) modern armies move and fight in a dispersed but coordinated fashion.[72] Hence, if one adopts the usual procedure of completing the operations of one entire unit or stack before starting on another (so as not to have to remember how many unspent operations points each unit has remaining), it is hard to launch a coordinated multi-hex attack halfway through the phase, and there is a risk that one unit will create a breakthrough at the end of its movement that another nearby unit will exploit before the gap should really exist. Breaking time down into shorter operations phases during each of which individual land units may *either* move or fight has significant merit as I will show in Chapters 9 and 11, and it is especially useful in tactical simulations since it allows forces to adopt 'fire and movement' tactics, but it does tend to increase overall playing time.[73] Both single phase and multiphase responses to the challenge of sequencing movement and combat thus bring numerous complications, and it is a matter of finding the 'least bad' compromise when structuring turns in simple wargames, as I will illustrate in Part III.

Every conflict simulation must necessarily model movement and combat, but some simple games omit logistic considerations altogether, and assume that all the antagonists remain supplied throughout the engagement.[74] As I have already pointed out, this tends to encourage continuous firing and activity by every element of the opposing forces, whereas in reality there were often numerous pauses and lulls, not least due to logistic shortages. The old adage that 'amateurs talk strategy while professionals talk logistics' reminds us that, however boring the supply dimension may be compared to sweeping manoeuvres and decisive attacks, it can have a critical impact on the course and outcome of military operations.[75] Realistic simulation of conflicts hence requires at least some consideration of logistic issues, and every one of my own wargame designs detailed in Part III includes a logistic element. The problem, as usual, is that too detailed a modelling of supply becomes self-defeating, since it would require tracking the

location and consumption of every scrap of food, water, ammunition and fuel throughout the campaign – it is this logistic burden above all that makes the notorious game *Campaign for North Africa* so ridiculously unplayable.[76] The trick is to find a far simpler way of modelling supply, which nevertheless captures its influence within the particular engagement concerned.[77]

In pre-twentieth-century campaigns, food, water, fodder and firewood were the main logistic elements, and these were mostly obtained locally because of the problem of shipping supplies over extended distances.[78] Shortages arose mainly when large forces operated in barren areas or outside the 'campaigning season', or when they tried to stay in or return through an already denuded region (as famously happened during Napoleon's retreat from Moscow in 1812).[79] A good way of modelling such dynamics may be to allow regions to become devastated by repeated foraging, and then to inflict heavy attritional losses on forces which try to stay there (especially over the winter) without established supply depots.[80] During actual battles in this era, ammunition limitations did constrain the activities of missile troops, as illustrated when Parthian horse archers annihilated a Roman army at Carrhae in 53bc thanks in large part to their commander having had the foresight to bring a camel train loaded with spare arrows.[81] Wargames rarely consider this aspect because it is inconvenient to record ammunition stocks for every individual unit, but there are easier ways of achieving much the same effect, such as using an off-map track to impose an overall limit on the number of artillery bombardments that may be made by each side during the entire game, or folding ammunition depletion into a more general provision for units to become progressively 'spent' as the engagement proceeds, as in my *Lost Battles* system.[82] Instead of tracking stocks directly, one can also use die rolls to create a gradual and randomised incidence of supply depletion (for instance by ruling that an individual firing unit exhausts its ammunition if it rolls a 6).[83] There are several examples of these approaches in Chapters 10 and 11.

Over the past 150 years, logistical considerations have been transformed as ammunition and fuel have displaced food and water as the most prominent consumables and as the rise of

mechanical transport has made continuous resupply from home production centres far more important than living off the land.[84] Simple wargames usually reflect this new reality by assuming that units that can trace a supply line of any length (unblocked by enemy units or vacant enemy ZOCs) to a friendly map edge or on-map supply source are automatically supplied and can operate indefinitely with undiminished effectiveness.[85] This is often qualified by rules that limit the distance over which supply lines may be traced before they reach a secure railhead or port, since a key feature of the new situation is that logistic strains are now greatest not for static forces but for advancing ones that outrun their established supply lines (as happened during Operation Barbarossa in 1941).[86] Units with attenuated supply lines or that are surrounded and cut off altogether from their logistic 'tail' are usually subjected to movement and combat penalties that may vary with time or with the degree of isolation. Some designers rule that encircled units are automatically eliminated if they cannot break out within a fairly short time, but this may be rather too draconian a penalty, since it removes the incentive for the enemy to attack and overrun the pocket as the Soviets had to do at Stalingrad.[87]

In some cases, the simple abstraction that all units that can trace a supply line are automatically in full supply proves inadequate, and it is necessary to limit the number of units that may draw supply each turn. This applies especially when there are overall supply shortages or when there are bottlenecks in the logistic chain, such as a reliance not on railroads but on trucks or air transports with their much lower carrying capacity (as happened at Stalingrad and in north Africa and northwest Europe during World War Two).[88] Supply throughput may also be reduced by poor weather, a lack of sufficient port facilities such as Antwerp, or enemy air or naval interdiction efforts like those launched from Malta.[89] One simple way of reflecting such constraints is to impose a variable cap on the total number of the affected side's units that may be supplied or activated each turn, depending on how severe the bottlenecks are.[90] Units further from the supply head may count at double or treble rate towards this cap because of the longer transit requirements, and players may be allowed to keep

their forces inactive and to accumulate unused points on a track so as to build up for a major offensive on a future turn.[91] Rules such as these can help enormously in simulating the episodic and back-and-forth nature of campaigns such as those in North Africa in 1940–43 and Korea in 1950–51, as both sides in turn reached the end of their logistical tether and were thrown back towards their supply bases.[92] Some wargames go further and include actual supply counters that must be moved laboriously up to the front (sometimes even using separate truck units), which are then expended when nearby combat units launch an attack.[93] This can produce a much more realistic simulation of the ebb and flow of hostilities, but the question as ever is whether the gain is worth the cost in complexity and playing time.

Veteran Napoleonic wargame designer Kevin Zucker once wrote that: 'It is important that the simulation of an event take a relatively limited point of view in its interpretation of that event. A game which presents more than a few interrelating points of view is a **very** complex game.'[94] As I pointed out in Chapter 2, one of the biggest liabilities of wargames is that they aspire to give a multidimensional and composite overview of a conflict, and so cannot just focus on simulating 'movement', 'combat' or 'logistics' in isolation. Incorporating realistic subtleties in an individual area seems perfectly manageable, but doing so in several areas at once greatly multiplies overall game complexity because of the crosscutting interrelationships produced. Since I have not yet even addressed the simulation of command, where exactly the same logic applies, the difficulties designers face in heeding Dunnigan's injunction to 'Keep it Simple' become readily apparent.[95] Manual wargames probably reached their peak of sophistication in the 1980s, with designers such as Joe Balkoski producing well-researched and clearly presented systems incorporating integrated operations phases, subtle combat interactions, detailed logistic modelling, and the highly interactive play sequences discussed in Chapter 7.[96] Unfortunately, the dozens of pages of rules and the dozens of playing time hours make these very impressive products hopelessly impractical as educational vehicles. Wargame designers have since shown increasing willingness to revisit earlier simplicities in an effort to make their work more accessible to non-

experts and those with limited time and in Part III, I demonstrate how such compromises might be reached so as to build on the very rich seam of past ideas and to try to achieve something of the best of both worlds.

7

Modelling command dynamics

As I discussed in Chapter 1, wargames unite operational research and game theoretic approaches to conflict, by creating detailed mathematical models of reality whose operation depends on the free choices of competing players. Since this mirrors the way in which real military forces operate according to the changing orders of their commanders, it is only natural that the players in the game are usually seen as the simulated equivalent of the overall commanders, just as the counters represent the actual military units and the map simulates the real terrain. Recreational wargames are often sold on the basis of this 'role-playing' dimension. For example, one of the earliest boardgame simulations of the Waterloo campaign proclaims on the box that: 'As the Duke of Wellington, you have defeated Napoleon's generals in six years of fighting in Spain. Now, at a little village in Belgium, you meet the master himself. Can YOU repeat the results of history, and crush the most powerful army in Europe? Play this classic historical campaign game and find out.'[1] A later simulation by the same company of the battle of Gettysburg conveys the equivalent message that: 'Robert E. Lee and George G. Meade were in command the first time. Now YOU can command at the famous battle!'[2] Injunctions such as these help to give recreational wargaming a rather bad name, by suggesting that its devotees are control freaks with delusions of grandeur, who like to play out in miniature their fantasies of leading armies and commanding the destinies of entire societies.[3] The reality is rather more prosaic, since frustrated ambition comes a poor second among wargamers to fascination with what makes real conflicts tick. As I mentioned in Chapter 2, most hobby wargames are actually played solitaire, with players adopting the schizophrenic device of commanding each side in turn as a

necessary expedient so that they may vicariously ‘experience’ the tactical and strategic dynamics of the struggle.[4]

The equation between players and real commanders is strongest in professional military wargames, which are designed explicitly to train future leaders and to help to plan real operations. In some cases, player and commander may actually be the same person.[5] Even here, however, the games simulate only the technical aspects of command, and not the much more important and stressful human skills of motivating and despatching subordinates to face deadly danger (and sometimes choosing to face it oneself while ‘leading from the front’, as commanders like Epaminondas, Alexander, Caesar, Gustavus, Nelson, Wellington, Jackson and Rommel often did).[6] In recreational wargames, once one moves beyond the sales hype, there is deep ambivalence about whether the games are really focused on placing players in the shoes of individual commanders.[7] Stephen Patrick and others have criticised any notion that skill in playing hobby wargames equates to an aptitude for real military leadership.[8] Dunnigan did design a simulation called *NATO Division Commander*, which focused on the staff work needed to run such a unit in combat, and (as I mentioned) the computer simulations by Panther Games allow players to assume any individual role within the command hierarchy, but most recreational wargames provide a much more composite and explicit overview of the engagement as a whole, more like an interactive history book than a leadership exercise.[9] I have always made clear that the wargames that I use in my own teaching and research (as detailed in this book and in my previous work *Lost Battles*) are *not* primarily command simulators, but are instead simple ‘working models’ of real conflicts, in which command is only one ingredient rather than the lens through which the entire simulation is viewed.[10]

In this context, the role of the players is not to display the same kind of personal command genius as leaders such as Napoleon or Rommel, but rather to supply each side with an element of tactical and strategic ‘common sense’ that is so lacking in the behaviour of the mindless automata modelled by Lanchester and his successors, whose fate rests purely on mathematical formulae. In the real world, forces may choose to

withdraw if overmatched, and to attack only where the enemy defences are weak. Human players can recognise such circumstances and make such prudent decisions, and the resonant interaction between the decisions of competing players on the two opposing sides creates subtleties and complexities that traditional mathematical modelling finds it hard to capture. Even the simple abstract games discussed in Chapter 3, whose rules could be outlined in a single paragraph, produce interactive decision dilemmas that could keep game theorists busy for a long time analysing the best choices at each stage. Real wargames with scores or hundreds of counters and zones, and with much more detailed rules for movement, combat and logistics, provide so many options at each successive stage that only the human talent for spotting the key essentials makes them playable at all. In the process, players can gain vital overall insights into the tactical and strategic dynamics of the real conflict being simulated, even if they do not experience the struggle through the eyes of an individual commander.

Modelling command dynamics in wargames is not about presenting the players with the kind of first-person perspective familiar from modern computer games of infantry combat or fighter dogfights, but rather about ensuring that the overall game system of rules and player decisions produces results not too dissimilar from the course and outcome of the actual engagement. The contribution of geniuses such as Alexander, Napoleon or Rommel is best modelled not by expecting individual players to display comparably superior insight relative to their adversaries (which is difficult at the best of times, and impossible when playing solitaire), but rather to treat such commanders as ‘assets’ just like their troops, and to hardwire the resulting advantages into the game rules themselves, as I illustrate in Chapter 9.[11] The impact of especially poor commanders or inflexible command arrangements is likewise best modelled by handicapping that side within the rules, rather than by selecting an inexperienced player to lead it.[12] Since the players in wargames are usually better placed to make clear decisions about the best course of action at each stage than are real commanders with all the distractions and uncertainties that they face, the role of wargame command

systems is more to *constrain* player choices than to facilitate them as with actual command arrangements.

Real conflicts involve masses of individuals, each driven by his own specific goals and fears. Reducing this multiplicity of motivations to a single abstract set of human inputs on each side is obviously very tenuous, just as the unitary rational actors of game theory give only a very vague reflection of the complex interplay of enormous and fragmented state bureaucracies.[13] A few two player wargames reflect this problem by elevating rivalry between forces and leaders nominally on the same side into the primary axis of conflict and by having the true common enemy governed by AI rules or even controlled by the rival player on each sector of the front – games on the collapse of Germany in 1945 hence sometimes take the form of rival Allied forces racing one another to Berlin.[14] A more common way of reflecting the fact that those caught up in a conflict do not fall neatly into two monolithic opposing camps is to use three or more players, each striving to achieve his own individual objectives, as I illustrate in Chapter 9.[15] Such multiplayer games inevitably transcend zero-sum conflicts, and encourage a degree of cooperation between certain players in order to further their mutual interests (as in the classic game *Diplomacy*).[16] Educational wargames benefit from a ready supply of players, and I often give different students or teams their own specific roles, as I discuss throughout Part III. However, since my main focus in this book and in my wider academic work is on modelling the military dynamics of armed conflict rather than the political dynamics of negotiation and diplomacy, my simulations all revolve basically around two-sided contests. I will say more in Chapter 8 about how one can model tensions within each of the two contending sides, especially those between different nations and between the military and political leadership, in a simpler way than by having each actor represented by a separate player.

As mentioned in Chapter 2, a key consideration in real warfare is how long it takes the combatants to respond to the changing situation. This applies especially at higher command levels because of the cascade of detailed planning required to change the orders of an entire force, but it is a factor even at the lowest tactical level.[17] Korean war fighter pilot John Boyd argued that

what gave the UN Sabre jets the advantage over the MiG-15 was not greater speed, climb rate or turning ability, but rather hydraulic flight controls, which allowed the more experienced UN pilots to shift more rapidly from one manoeuvre to another, leaving their communist opponents struggling to react in time. Boyd later generalised this insight into a concept of 'decision cycles', according to which each force engaged in any kind of conflict is constantly repeating the process of observing the current state of affairs, orienting itself to the new situation, deciding what to do, and then implementing its action – a process that he termed the 'OODA loop'.[18] Boyd's ideas have become quite influential, since they seem to explain how a more agile force can 'get inside the enemy decision loop' and leave its adversary floundering, as the Germans and later the Israelis did with their fast moving armoured offensives.[19] This image of command as a constant iteration of decision cycles fits quite well with the system of dividing wargames into turns, in each of which the players can assess and react to the new situation with which they are faced.[20] However, how best to tailor the turn system and the sequence of play to give a simple yet realistic representation of command dynamics in the particular conflict of interest is a very challenging problem.

The simplest and most common approach is to split each turn into two symmetrical 'player turns', during each of which the active side gets to move and attack while its opponents stand and watch.[21] Such alternating player turns are obviously rather artificial as a reflection of the simultaneous reality captured in 'real-time' computer simulations and they are now rather dismissively referred to as 'Igo-Ugo' systems.[22] However, alternating player turns do have significant advantages besides simplicity. In tactical land games, where units may either move or fire in a single turn, they are a good way of ensuring that stationary troops get to fire first against enemies who move into view, as I will show in Chapter 11.[23] In other simulations, alternating player turns offer a straightforward way of reflecting how quickly forces of that era can cycle through the OODA loop and react to a new situation. If reaction times are short compared to the pace of operations themselves, then a larger number of shorter turns will make game play more interactive and give both

sides the chance to respond quickly to unexpected challenges or opportunities. Conversely, if reaction times are long relative to the pace of operations, then a smaller number of longer turns, perhaps with move–fight–exploit phases within each player turn, will allow either side to break through at points of weakness and sweep forward to encircle enemy troops before those troops have a chance to withdraw or to seal the breach. This is a very simple way of simulating the difference between prolonged attritional duels like those in World War One and fast moving *Blitzkrieg* warfare like that in World War Two, characterised by the frequent 'pocketing' of enemy formations.[24] Alternating player turns also neatly reflect the episodic nature of real military operations, with successive flurries of offensive and counteroffensive action by each side in turn (as in the fighting around Stalingrad) being much more common than truly simultaneous attacks.[25]

Various measures have been used to soften the starkness of alternating player turns, at the cost of somewhat greater complexity. In tactical games, 'non-phasing' units are often allowed to fire defensively during the enemy player turn, and there are also provisions for 'opportunity fire' against units that expose themselves in the middle of their move while dashing from cover to cover.[26] In operational simulations, non-phasing artillery can often contribute 'final protective fire' to support whichever frontline units come under attack and there is sometimes a phase for 'reserve movement' in the middle of the enemy player turn, during which friendly units that have been placed in reserve during their own preceding player turn may react to enemy initiatives before further damage is suffered.[27] Since turns are inevitably of a common length for the two sides, it is hard to reflect directly Boyd's model of opposing decision cycles being dissimilar in duration.[28] However, designers often capture such asymmetries indirectly by constraining one side more than the other within each turn, either by varying the availability of command points as I discussed in Chapter 6 or by using different phase structures for each side's player turns – a move–fight–exploit sequence leaves far less scope for enemy reaction than a fight–move sequence, especially if the latter is interrupted by a phase for enemy reserve movement.[29] A simple way of tweaking alternate player turns to

allow one side to get inside the enemy decision loop is to reverse the turn order at a decisive moment, thereby giving the affected side two player turns in succession – I use such a 'flip-flop' mechanism in my *Lost Battles* system to reflect the genius of brilliant generals such as Alexander, Hannibal and Caesar.[30]

The alternative to the Igo-Ugo system is to adopt a more integrated approach to the two sides' actions within each turn. The simplest way of doing this is to have both sides move before any combat is resolved. This is often the approach adopted in air and naval simulations, because the craft are moving constantly and what matters is their relative positions at any given instant. The trouble is that whichever side moves second before the joint combat phase has a tremendous advantage, because it can evade unfavourable combats while pouncing where it enjoys superiority. Alternating which side moves first from turn to turn may even things out overall, but it creates a wholly artificial 'pendulum of advantage' that may severely distort player decisions.[31] The problem can be reduced by interleaving the two sides' movement in some way, for instance, by having each side take it in turns to move a single unit, but this increases complexity and gives a disproportionate benefit to the side with more units. Some designers have sought to evade the problem altogether by requiring players to write orders for all their units at the start of the turn (or even for several turns ahead), and then to execute these orders simultaneously.[32] This directly simulates how orders may be overtaken by events, but it is very time consuming, and it creates difficulties of its own when the plotted movements clash or when vague overall orders leave undue scope for player interpretation.[33] It is better where possible to make a virtue out of the problem of which side moves first and to use it to address other asymmetries as I will discuss shortly.

The other common way of achieving a more integrated play sequence than in the classic Igo-Ugo system is to have the two forces activated in successive 'impulses', in each of which only a part of one force moves and fights.[34] Which units are activated in each impulse may be left up to the alternating discretion of the players or it may be decided randomly (typically by drawing counters from a cup that holds a chit for each multiunit formation

on the two sides).[35] This system makes it hard to coordinate the actions of different formations and it risks having enemies penetrate into the gap between an advancing formation and one that has not yet been activated to join it, but most wargamers see these consequences as advantageous in simulating the confusion and chaos of manoeuvre warfare.[36] Designers often include quite elaborate rules allowing one side or the other to 'seize the initiative' so as to carry out or to frustrate just such a coup, and this obviously provides ample scope for simulating the decision cycle asymmetries Boyd described.[37] In systems where activation is discretionary rather than random, players often 'pass' at various points in order to maintain fresh reserves for later in the turn and this can produce the very realistic result of some units being left unactivated if the other player also 'passes', thereby ending the turn.[38] A less welcome consequence of the impulse system in tactical games is that defending units often face the artificial dilemma of whether to fire on available targets while they have the chance, at the risk of becoming 'spent' for the turn and so allowing other enemy units to approach even closer with impunity.[39] As I will show in Chapter 11, in Igo-Ugo systems, it is much clearer what the key targets are at any given time, and there is a more realistic simultaneity about the actions of each side. Impulse systems have become very popular in full-size wargames since the 1980s, and their main drawback from my point of view is that they are more complex and time consuming than alternate player turns, making their suitability for educational microgames far from clear.[40]

Very similar considerations apply to the next major area to be considered when modelling command dynamics, namely how to handle the fog of war. By far the most common criticism of the realism of recreational wargames is that they give players much clearer and more definite information than is available at the time to real military commanders.[41] Not only do most wargames display the precise location and capabilities of both sides' forces for all to see, but they also lay out clear rules for what may and may not be done and for what either side must achieve to win. Clausewitz, by contrast, wrote that: 'War is the realm of uncertainty; three quarters of the factors on which action in war is

based are wrapped in a fog of greater or lesser uncertainty.' He went on to state that: '[T]he imperfection of human perception and judgement … is more pronounced in war than anywhere else. We hardly know accurately our own situation at any particular moment, while the enemy's, which is concealed from us, must be deduced from very little evidence.'[42] One need only recall the yawning uncertainties and misperceptions during the recent conflicts in Iraq, Afghanistan and Libya to understand the truth of Clausewitz's words. It is hardly surprising that, in a recent issue of *Battles* magazine, one designer dismissed wargames without fog of war rules as merely 'chess with dice', while veteran wargamer Charles Vasey described my own simulations of ancient warfare (which I will outline in Chapter 9) as historically accurate but too statistically calculable to give a feel for the 'strategic mystery' that the real generals faced.[43]

Professional military wargames focus heavily on direct simulation of the fog of war, given their ready access to facilities and personnel, and given their role as leadership exercises rather than just working models of conflict dynamics. As I explained in Chapter 3, the whole *Kriegsspiel* paradigm of Red and Blue teams confined to separate rooms from the umpires is intended to limit the information available to the players and to encourage them to focus on real military considerations rather than on the artificial mechanics of the game itself.[44] Recreational games are perfectly capable of mirroring these arrangements, as with *Dungeons and Dragons*, which typically involves several 'adventurers' exploring the unknown labyrinth created by an all-powerful 'games master' or as with the occasional 'megagames' in which dozens of individuals come together to refight a particular historical conflict, with around one-third of their number joining the team of umpires rather than taking a command role on either side.[45] Board wargame designers are usually reluctant to assume the availability of anyone other than two opposing players who must hence run the game for themselves, but this does not preclude the inclusion of at least some elements of limited information, as shown by the very simple games that I described in Chapter 3. Such incorporation of the fog of war was fairly rare in the early days of board wargaming, but it has become much more common.

In the recent issue of *Battles* magazine to which I just referred, no fewer than six of the eleven new games reviewed had systems that kept key information hidden from one or other player, while a further four were purpose-built solitaire games – only one simple microgame on the first battle of Bull Run fell into the more traditional open paradigm, playable either by two players or by a single player swapping sides.[46]

Various techniques have been used to build the fog of war into manual wargames.[47] The simplest is to prohibit players from looking through stacks of enemy units to determine the composition of the entire force.[48] Greater uncertainty may be created by recording the strength of on-map counters only on secret off-map tracks, or by requiring one or both sides' counters to be moved face down, with only the owning player allowed to peer beneath them to see which units they represent.[49] Since both of these expedients are rather clumsy, some deluxe games instead use counter stands or wooden blocks so that the units may be stood on end with their details visible to their owner while the other player sitting opposite sees only their anonymous blank backs.[50] Square blocks allow the further refinement that the units may be rotated orthogonally to show their current strength at the top, thereby recording up to four steps of strength as well as concealing this from the adversary.[51] To prevent players learning too much from the mere presence or absence of enemy counters, some games allow one or both sides to use a certain number of dummy counters in addition, although this does, of course, require extra rules to cover the movement, disclosure and possible re-spawning of these phantoms.[52] The reverse approach of leaving some of one side's real units off the map and plotting their position secretly is also occasionally employed.[53] The ultimate way of simulating ignorance of enemy dispositions is for the two players to sit back to back, each with an identical map containing his own units, and to discover enemy units only by announcing a 'search' in a particular zone. This 'double-blind' system has been used in some land wargames and works by each player marking the enemy frontline and calling out each enemy-held zone that his forces try to enter.[54] The system is more commonly employed in operational naval simulations, although here there has never been

a satisfactory answer to the obvious problem with non-umpired manual games that explicitly searching a sea zone and finding it vacant reveals to the enemy where one's own forces are, and so can be rather counterproductive.[55]

Other design techniques have been used to create uncertainties about wider aspects than just enemy force dispositions and some of these techniques are much more compatible with solitaire play since they conceal information from both sides simultaneously. They include mixing up one side's units and deploying them with only a generic 'untried' face showing, so that neither player knows a unit's true fighting value until the first time it engages in combat.[56] Other solitaire-friendly techniques include basing the play sequence on random chit draws rather than a set structure or imposing a series of 'random events' from a die roll based table or from the gradual revelation of a deck of cards.[57] Cards are used in a more traditional way in many recent wargames as a means of allowing each player to 'draw' certain capabilities or events and to hold them secretly before 'playing' them at a judicious moment.[58] There are now plenty of 'card-driven games' in which such card play is the basic mechanism governing the capacity of the opposing forces to move and attack – this fits well with Clausewitz's description of war as a *Kartenspiel*, and with his argument that, 'immobility and inactivity are the normal state of armies in war, and action is the exception'.[59] Having simulated the fog of war by limiting the information available to contending players, some designers then go further and devise explicit provisions for intelligence and reconnaissance operations, to help lift the veil by means other than simply blundering into the enemy.[60] Such rules are most common in simulations of duels between carrier task forces, traditionally using a 'double- blind' approach involving extensive provisions for intelligence and aerial reconnaissance as both sides strive to spot the enemy and launch the first decisive strike.[61]

Since direct simulation of the fog of war is clearly possible even without using umpires or computer assistance, why does none of the games that I describe in Part III involve asymmetric access to information as do my simpler games in Chapter 3 and Appendix 5, and why do I advise my MA students to think very

hard before incorporating such secrecy into their own designs? As I argued in a more recent issue of *Battles* magazine, one-sided player access to information, which works so well in the hypothetical context of *Kriegsspiel*, is actually a rather mixed blessing when applied to simulations of historical battles and campaigns,[62] for two principal reasons. First, information asymmetries increase complexity and playing time, and make it harder to test and experiment with games and to use them effectively in class. All fog of war systems make manual game mechanics harder to implement, since guarding and revealing secrets is inevitably clumsier than working with explicit and clearly visible data. Testing the games is especially problematic, since the designer cannot do so alone but only with the help of at least one colleague, a significant constraint during the usual protracted and iterative design process. Although it might be thought that the class context provides ample numbers of people to make information asymmetries viable when playing the finished games, this is not necessarily so. Beyond the very simple games described in Chapter 3, students often struggle to understand the details of this unfamiliar approach to conflict study and they cannot be relied on to make sensible decisions and avoid rules mistakes if the more knowledgeable facilitator is precluded from giving hints, correcting errors and explaining the model as it proceeds lest this jeopardise the fog of war. Games with limited information can create memorable experiences of bluff and double-bluff as the players strive to outguess one another, but this can be at the expense of a clear overview of the strategic dynamics of the specific historical conflict being studied.

This leads on to the second problem with direct simulation of the fog of war in historical wargames, namely that hindsight makes it very hard to reproduce the uncertainties and misperceptions that existed in reality. Some designers have done their best to tackle this problem by introducing massive levels of variation into their game scenarios.[63] For example, Varus may be tempted to repeat his disastrous march through the Teutoberg Forest in ad9 by making the historical ambush less likely than a demanding schedule for collecting tribute from cowed natives, while the French in 1914 may be tempted to repeat their bloody

offensives in Alsace-Lorraine by a game system in which *élan* really may turn out to be superior to defensive firepower.[64] The trouble is that the resulting uncertainty is bought at the very stiff price that most individual games will be grossly ahistorical, because the real scenario can only be allowed to occur on a minority of occasions if player misperceptions are to be maintained. Some hobbyists rather like the 'chaotic' feel this variability creates, but for academic purposes it is hard to justify getting students to spend precious class time on a single refight based on such potentially fantastic premises.[65] The alternative of trying to 'disguise' the scenario (usually by shifting it to a different period so that players do not realise what historical action they are refighting until it is too late) smacks of desperation and is equally problematic as a means of studying the real events.[66] It is surely preferable (as discussed earlier) to portray the game as an interactive history book rather than as a command simulator and to try to model the real engagement as faithfully as possible while using other means to prevent hindsight from distorting player choices and so derailing the whole enterprise.

The key to indirect simulation of the fog of war is to exploit to the very maximum the one dimension of uncertainty that exists even in a game of chess, namely uncertainty over what may happen next. In chess, this uncertainty revolves only around what the other player may do, but in 'chess with dice', there is the vital added dimension of random variation. In reality, combatants tend to be lucky on some occasions and unlucky on others, as when breakthroughs are achieved at unexpected places due to a fortuitous combination of circumstances. It would clearly be ill advised for wargame designers to try to reproduce exactly the same sequence of good and bad luck that occurred in a real conflict, not only because this would create a ridiculous degree of hindsight-based prescience, but also because events will diverge from reality anyway thanks to different player decisions. Hence, what designers do instead is to study the overall distribution of outcomes across a wide range of similar phenomena and then build a system that yields a similar overall range of effects in the game, but with good and bad luck occurring randomly in each successive instance. For example, in my ancient warfare

simulations, generals who join the fighting to rally their men face a small risk of being killed on each occasion, while at the strategic level, one region chosen at random will revolt in each decade – players have no idea when or if a particular general or region may be lost, but across the games as a whole, a realistic level of deaths and revolts is achieved.[67] Random variation plays a key role in negating detailed hindsight while keeping overall simulations in tune with historical precedents (I discuss the topic further in Chapter 8).

The other crucial dimension is uncertainty about what the opposing player will do next. Just as alternating player turns can capture something of the delayed reaction times in real warfare without the need for much more complex and time-consuming approaches such as written orders, so they can model the potential for surprise without requiring asymmetric access to information to be incorporated directly into the simulation. The more that one side can move its units each turn before launching attacks (as in the traditional 'move–fight' sequence), the more that it can alter its dispositions to pounce on evident weaknesses, thereby encouraging the opponent to minimise such weak spots by offering a balanced defence across the entire front, based on the terrain and the strategic value of each region rather than on knowledge of the enemy deployment. Hence, regions like the Ardennes will tend to be thinly garrisoned even in wargames that do not cloak enemy dispositions from the competing players, since posting strong defences in such tangled country will denude other areas with more open terrain and so will tempt the opponent to attack there instead.[68] Asymmetries in the intelligence contest between the two sides may be simulated indirectly by varying their respective capacities to move before attacking, either on a turn-by-turn basis or more systemically within the simulation as a whole. At the extreme, adopting a 'move–fight' sequence for one side and a 'fight–move' sequence for the other is very close to a system in which both sides move before combat is resolved, with the side that moves second having a tremendous intelligence advantage – Richard Hamblen's game *Victory in the Pacific* uses exactly this approach to model the beneficial effects of US codebreaking in 1941–45 without any need for direct simulation of

the fog of war.[69] Particularly devastating surprise attacks such as the Soviet encirclement of Stalingrad are often best handled by starting the simulation at the precise moment when the attack is launched – as I will show in Chapter 10, this has the great advantage that exact historical dispositions may be used, thereby making refights much less variable than if employing a free setup with the attackers deploying second to give them the advantage of surprise.[70]

The liberation of France in 1944 offers a very good illustration of how indirect simulation techniques (often described as 'design for effect') can be at least as worthwhile overall as more direct and explicit modelling of the fog of war and the intelligence contest.[71] The French campaign is renowned for its intelligence dimension, due to the insights that Ultra, aerial reconnaissance and clandestine agents gave to the Allies, and due to the success of the Fortitude deception operation in misleading the Germans even after the D-Day landings had occurred.[72] One or two wargames do focus specifically on this intelligence contest, by revolving around the struggle to guard or reveal the long-planned secret that the invasion would occur in Normandy.[73] However, other games give the Allies the freedom to decide on the spur of the moment where to launch their main invasion, as well as the later follow-up landings that occurred historically in the south of France. This obviously does not properly reflect the degree of pre-planning needed for such major enterprises, but it does encourage the Germans to spread out their defences so as to avoid leaving evident weak spots (especially near the Reich itself), and it also very neatly impels them to continue guarding the Pas de Calais even after D-Day lest the follow-up invasion arrive there instead (as Operation Fortitude pretended it would).[74] Other simulations of the campaign adopt a less variable and more historical approach, with both German and Allied forces starting the simulation deployed as they were in reality after the first wave had landed on D-Day and with command limitations preventing the Germans from moving all their troops at once to seal off the Normandy beachhead.[75] Clearly, there is more than one way to skin a cat, and simple indirect simulation techniques offer significant advantages when modelling the intelligence dimension, especially

when designing educational microgames in which the main challenge is to minimise complexity and to reproduce historical patterns without play being distorted unduly by hindsight.

As I said earlier, wargame command systems serve more to *constrain* than to facilitate player actions, since otherwise, players tend to treat their forces as obedient telepathic heroes subject to clear direction by an all-seeing 'hive mind'. One means of constraint (discussed in Chapter 6) is to give each player only a limited number of command points with which to conduct actions each turn. This still allows players to focus their command points on whichever troops they can see from their God-like perspective are most crucial each turn, so some designers introduce more specific constraints to inhibit such rational direction. In modern card-driven games, this is achieved by prohibiting players from taking certain actions unless they have drawn and are holding the requisite card, while in some earlier simulations, a varying proportion of units (selected at random) are subject to 'panic' each turn and instead of following player orders they will freeze in place, retreat, or perhaps even move in a random direction to reflect a complete breakdown of command and control.[76] In games that include multiple commanders, each in charge of a distinct formation, it is routine to represent each leader by a counter containing various ratings to reflect the differing abilities of the real individuals concerned. Commanders can hence boost the movement potential, combat strength or recovery speed of their troops to a varying degree and over a variable geographical range, and there may be a system whereby they may only be activated at all in a particular phase if a die roll does not exceed their personal initiative rating.[77] The more that commanders at all levels are represented as 'assets' in this way and the more indirect the simulation of command delays and the fog of war, the clearer it is that the role of the players is to contribute abstract collective common sense while studying the overall strategic dynamics of the conflict, rather than to experience the perspective of any real individual.

Sometimes, one side in a conflict was so badly informed and so handicapped in its command flexibility that allowing a player to direct its simulated actions causes more problems than it solves.

In such cases, manual wargame designers often produce rudimentary AI provisions to allow that side to operate automatically, with no need for player decisions.[78] The result is to create a purpose-built solitaire game, in which the single player controls the other side and tries to beat the game system using his or her much more flexible human insight. A significant advantage of this approach is that it allows direct simulation of the fog of war without any of the complications of asymmetric access to information, since there is no opposing player who should be privy to the secrets held within the game system. I exploited this characteristic to the maximum when I designed a generic solitaire game of a paratroop company racing to secure an enemy-held bridge, as happened on the first day of Operation Market Garden in 1944. There were counters representing potential enemy positions in each hex of the randomly placed woods and each counter was diced for to see if it opened fire when any paratroopers moved within killing range. The paratroopers could minimise their losses by cautiously approaching each counter in turn, but the problem was that the fewer real enemy positions there turned out to be, the sooner the bridge would be blown. The system was endlessly replayable, and it took a delicate blend of boldness and caution to secure the bridge in time without being pinned down by a devastating ambush.[79] There are now scores of published solitaire wargames that exploit these kinds of mechanism to challenge lone players, and around 10 per cent of the student projects in my MA conflict simulation class have been solitaire designs.[80]

As in my paratroop game, the side controlled by AI is usually an ill-coordinated defensive force that needs only be given priorities for opening fire and rules for sporadic counterattacks against the player-controlled aggressors. Antagonists governed by such automated responses in published wargames range from Alexander’s Persian opponents to Japanese island garrisons in World War Two and the Iraqis facing Operation Desert Storm.[81] However, there are also solitaire games in which the AI controls a poorly informed attacking army such as the Union forces at Antietam or the North Vietnamese in the Ia Drang campaign in 1965 – here, there needs to be more complex provisions for

movement and attacks by the forces concerned.[82] Solitaire rules are proportionally more common in naval and air simulations, probably because there are not the same problems over maintaining a coherent frontline and because the emphasis on searches and detection makes it harder to design operational or strategic naval and air wargames that do not use either limited intelligence or dedicated solitaire techniques.[83] John Butterfield's *RAF* is one of the best solitaire simulations ever published, since its use of card draws to generate Luftwaffe raids not only captures well the shifting and ill-informed nature of German strategy in 1940 but also conceals the size and composition of the raids until British fighters have been committed.[84] Dunnigan's *Wolfpack* is similarly effective in steering real or dummy Atlantic convoys along zigzag courses and away from spotted U-boats, but solitaire games of aircraft carrier battles are more problematic because of the more complex AI needed to simulate reconnaissance and strike operations.[85]

Since AI is often the weak point even of computer wargames with their ever increasing processing power, it might reasonably be asked how on earth manual AI systems can simulate real human actions with any degree of realism. The answer is that the behaviour of actual combatants was sometimes so badly afflicted by ignorance, incompetence and lack of coordination that a mixture of randomisation and simple automated priorities such as 'fire on the closest target' or 'move towards the nearest enemy' may give at least as good a simulation as handing control to a human player who is then saddled with extensive and frustrating 'idiot rules' to prevent more subtle tactics being applied. Even some two-player wargames of conflicts such as Midway or the 1991 Gulf war include a historical scenario in which the losing side is governed by special solitaire rules, since that is the only way the designer can think of to make that side perform as poorly as it actually did.[86] The trouble with AI systems is that their reactions are entirely predictable and that even randomised AI responses are susceptible to precise statistical calculation by the active player, so that prevailing over them is like solving a puzzle rather than outthinking a live opponent who might respond to defeat by trying a different and unexpected strategy next time around.[87]

Purpose-built solitaire wargames hence provide a one-sided learning experience in which the player gradually learns to ‘crack’ the system after repeated early defeats (just as in most single player computer games).[88] They pose fascinating design challenges, but (as with chess) wargames with active player inputs on both sides allow far greater interactive variation and so offer a much richer vehicle for academic study.

As mentioned earlier, traditional ‘dual-purpose’ manual wargames that can be used either by two players or by a single player swapping sides have come under increasing challenge recently from dedicated solitaire designs and from two-player simulations using cards or blocks to conceal secrets. A key reason for this shift is undoubtedly that the systemic openness of dual-purpose wargames is seen as unrealistic compared to the real command experience of pervasive uncertainty, which can be captured much more directly by specialised two player or solitaire simulations. I think that this puts too much focus on the games being role-playing command simulators rather than more abstract working models of the overall conflicts concerned. The command simulator paradigm fits very well with the hypothetical clashes of *Kriegsspiel*, but in historical wargames it produces dreadful dilemmas such as how to avoid hindsight’s distorting influence without introducing such wide variations in the initial scenario that most games will be grossly ahistorical.

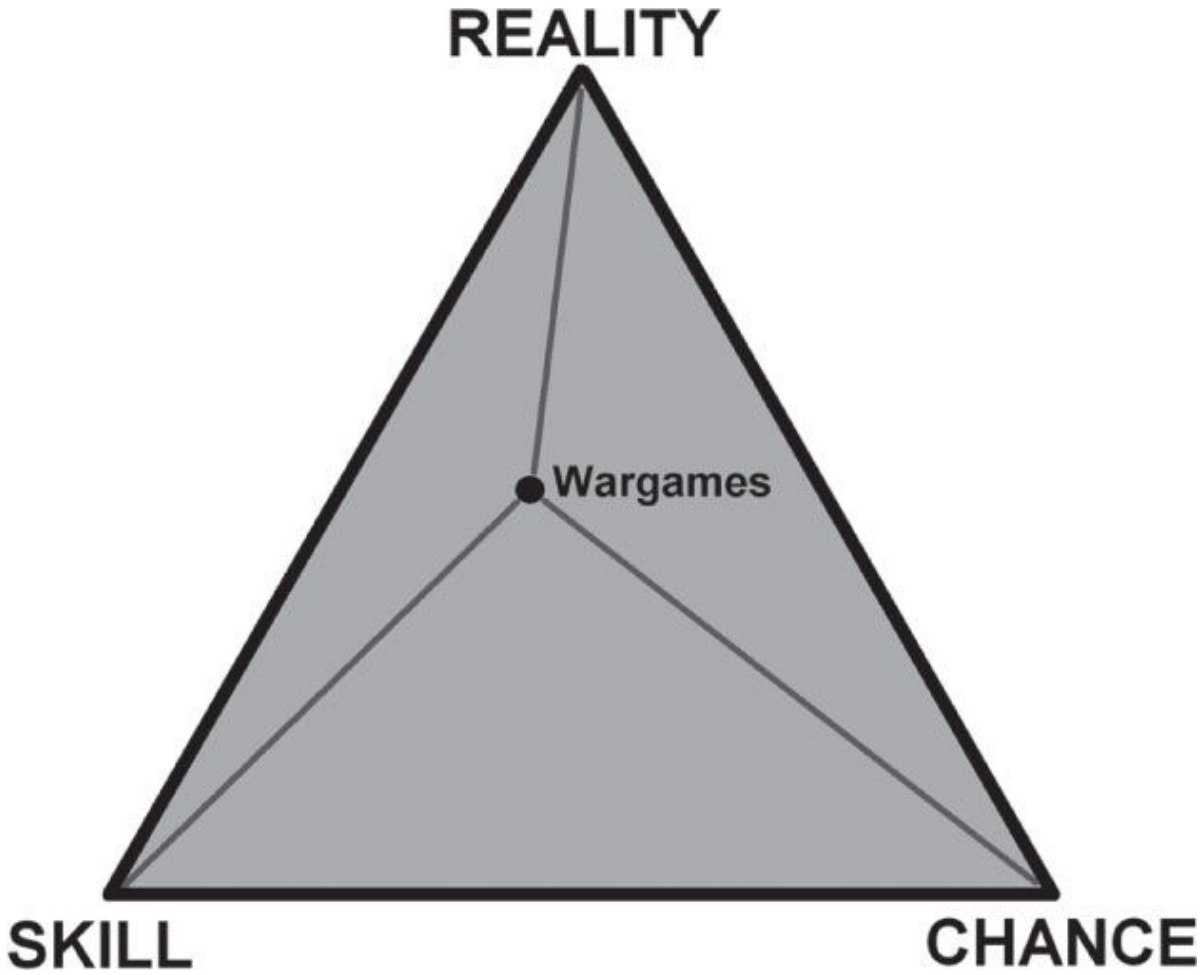
To my mind, it is better for players and designers to see themselves not as surrogate commanders but as counterfactual historians, tinkering with an interactive model of real events as they explore why the engagement developed as it did and how things might have gone differently. Dual-purpose wargames are better suited for such academic study than more specialised systems of either kind, since a lone designer can freely test and experiment with them without subjecting one side to inflexibly rigid AI control, and then can use the games in class and let as many non-expert students as possible take part while retaining a clear personal overview of the opposing dispositions and so being able to keep the game moving and head off damaging tactical or rules mistakes by either side. Years of experience running wargames for students and others unfamiliar with the game system have

taught me that this approach of ‘guided competition’ is the best way of giving players a sense of direct involvement while allowing them to rely on for me for detailed advice and commentary on the rules, the design principles and the underlying history. How to encourage players to adopt historical strategies when they can see clearly from the unit strengths and dispositions that other alternatives seem militarily preferable is a key challenge to which I will return in detail in Chapters 8 and 9.

8

Integration and testing

As reflected in the three preceding chapters, wargames are a composite of three constituent elements – physical components (map and counters), rules system, and decisions made by individual players. The course and outcome of wargames are themselves determined by a combination of three principal factors, namely reality, skill and chance. Figure 8.1 provides a graphical illustration of this key triad of factors. The corners of the triangle correspond to extreme cases where one factor predominates, to the complete exclusion of the other two. The top corner might represent a book about the engagement, which always tells the same story regardless of the reader's own input. The bottom left corner might represent a game of chess, which depends entirely on player skill and which has scarcely any element of luck and no significant relationship to any real armed conflict. The bottom right corner might represent a game of Snakes and Ladders, which again bears no relationship to reality but which this time depends purely on chance and not at all on skill. All conflict simulations fit somewhere within this triangle, and their closeness to each of the respective poles reflects the proportional influence of reality, skill and chance within the wargame as a whole.



8.1 The three key factors which influence wargames

One need only imagine describing historical wargaming as a blend of history, chess and Snakes and Ladders to see which of the three factors is by far the greatest liability. Dunnigan himself summed up wargaming as ‘glorified chess’, but to describe it as ‘glorified Snakes and Ladders’ would be a much more derogatory comment.[1] Sceptics routinely focus on the chance element as a means of dismissing wargames as childish trivia, as with the television critic who damned the show ‘Game of War’ in 1997 with the statement: ‘When opposing forces meet, a die is thrown to see who comes out on top.’[2] As discussed in Part I, professional wargamers are very sensitive to such scepticism, which is one reason why computer programs with internal random number generators have mostly displaced explicit die rolling as in manual military games of the past.[3] Professor Robert Rubel of the US Naval War College described recently how a run of bad luck prompted one frustrated officer to exclaim: ‘This is a dice game,

not a capabilities game!', and Rubel himself went on to argue that: '[I]t is not valid to substitute dice rolls for unmodeled aspects of reality.'[4]

It is entirely possible to design wargames with no chance element whatsoever, placing them somewhere along the left-hand edge of the triangle in Figure 8.1. I published just such a wargame in 1993 – a very simple simulation of three dozen ancient land battles, which had perfect information just as in chess, and which was shaped entirely by player decisions without any random ingredient.[5] However, it was not long before I added a simple die roll system to make combat less precisely calculable (the number of attacking units required in order to rout an enemy unit rose by one on a roll of 1 and fell by one on a roll of 6), and similar random variation remained a feature of all subsequent developments of the system until its ultimate expression in my *Lost Battles* book in 2007.[6] The number of published wargames that omit chance elements altogether is vanishingly small, at least once one realises that luck comes from other sources than just rolling dice – any element of secrecy or uncertainty in a game makes it partly a matter of chance whether the players guess right or wrong, as the simple games in Chapter 3 and Appendix 5 with their secret deployments and action choices illustrate very well.[7] Since military wargames with human players have always focused heavily on direct simulation of the fog of war, they inescapably include a significant slice of luck, whatever use they make of random number generation. The more uncertain the environment, the more that player decisions depend on chance rather than skill, although the illusion of control is much stronger in a tense contest of bluff and double bluff than in an impersonal die roll or coin toss. (To take a simple example, if one player can choose to hide in one of two locations and the other player can choose to search in one of the two locations, it is purely a 50:50 chance if the first player is found – there is no skill element at all, and tossing a coin would have exactly the same effect.)

Given Clausewitz's stress on uncertainty as a key characteristic of warfare, it is hardly surprising that he wrote: 'War is the realm of chance. No other human activity gives it greater scope: no other has such incessant and varied dealings with this

intruder. Chance makes everything more uncertain and interferes with the whole course of events.'[8] This notion of chance and incalculability underlies Clausewitz's whole theory of war, as in his famous concept of 'friction', according to which: 'Countless minor incidents – the kind you can never really foresee – combine to lower the general level of performance, so that one always falls far short of the intended goal.'[9] It is very telling that Clausewitz compared war to a game of cards rather than a game of chess. He prefaced that comparison by writing: '[A]bsolute, so-called mathematical, factors never find a firm basis in military calculations. From the very start there is an interplay of possibilities, probabilities, good luck and bad that weaves its way throughout the length and breadth of the tapestry.'[10] If the fog of war is to be modelled indirectly rather than directly (as I argued in Chapter 7 was a preferable approach in academic simulations), this makes it all the more important that random factors be included within wargames, despite the image problem that this creates among sceptics. The real question is not whether luck should be a factor at all, but what is the most appropriate *balance* of luck and skill to underpin variations of wargame outcomes from the single course of events observed in the real conflict.[11] (I will discuss in Appendix 3 how to work out the degree of randomness that a given die roll system introduces.)

Chance variation has the great advantage that it is usually much simpler to implement than are truly skill-based determinants. The simplest imaginable 'simulation' of the Second World War might take the form of a single die roll – on a score of 1, the Axis powers secure a negotiated peace after their initial conquests, on a score of 2 to 5 they are defeated after several years of hard fighting, and on a score of 6 they collapse in fairly short order. As discussed in Chapter 4 and illustrated in Figure 4.1, the spread, locus and shape of this distribution of outcomes embody multiple historical and counterfactual judgements that would require an entire book to justify, but the game itself takes only a few seconds to resolve.[12] It is obviously utterly pointless to make such a die roll in isolation, but if my example instead referred to an individual campaign such as the Battle of Britain, which needs to be modelled within the broader context of a simulation of the whole

Second World War, then the modelling of that campaign might well take the form of a single die roll, with the range of possible outcomes carefully tailored to reflect the designer's informed judgement of what might plausibly have occurred in the campaign and how this would influence the wider war.[13] However detailed and complex a wargame may be, it always comes down at the lowest level to a combination of many individual sub-contests that may either be made entirely predictable and unvarying in their outcomes or must be resolved through some random mechanism such as a guessing game or the roll of a die. The crucial point is that this use of dice does *not* make these sub-contests entirely a matter of luck, with both sides having a 50:50 chance of prevailing – the rules will tailor the distribution of outcomes in each case according to the strength ratios, terrain, and all the other pertinent factors discussed in Chapters 6 and 7.

Arranging these factors to give the best possible chance of one's own side prevailing in the most important sub-contests and hence in the simulation as a whole is, of course, where player skill comes into the equation. In Chapter 11, I illustrate some ways in which random variation may be managed in game systems to place the emphasis more on judicious player choices than on sheer luck as a determinant of success. In some real conflict situations (such as heavy bomber crews flying through flak barrages), the skill of the combatants made very little difference to their exposure to random peril, and so low-level simulations of such conflicts tend to take the form of solitaire 'experience games' in which the player must just hope that none of the successive die rolls causes catastrophe.[14] However, the great majority of conflicts do present the antagonists with tactical and strategic choices that help determine the course and outcome of the contest and it is these choices that players of wargame simulations must grapple with (and so understand better) as they struggle to prevail. The key thing is to give the players options other than simply mirroring what was done in the real conflict. Designers and players can then explore what happens if one or both sides depart from the historical script and they can use such counterfactual experiments to raise new questions about what occurred in reality.

In strategic games, the choices concerned revolve not just around the military aspects on which this book is focused, but also

around political and diplomatic questions such as whether and when to initiate hostilities against or make peace with particular states, and sometimes even which side to join in an ongoing struggle. As I illustrate in Chapter 9, such choices may be simulated directly by means of multiplayer games in which each player controls a particular state or faction and has her own tailored set of objectives, but in this case the political aspects predominate and the military simulation takes second place. More militarily focused wargames with just two opposing camps hence need to include simple political subsystems to reflect the changing cast of belligerents. One common rule is that neutral states will remain inactive unless attacked, at which point they join the opposing side. More subtle provisions are needed in cases such as US and Soviet involvement in World War Two and this is usually handled by ruling that these states will join the Allied cause after a certain point, even if the Axis powers have not yet chosen to attack them.[15] In cases in which a combatant state historically came to terms before being completely overrun (as did Russia in 1917, Germany in 1918 and France in 1940), it is fairly easy to model the requisite circumstances, but in hypothetical cases such as a British or Soviet surrender in 1940–41, there is obviously much more room for debate about the triggers that would have been required.[16] Taking historical political choices as a baseline and then tweaking them using a mixture of random variation and an assessment of the current strategic situation in the game usually offers the best way of automatically modelling political decisions, by creating an appropriate blend of reality, skill and chance.[17]

If play of a wargame suggests that the tactics and strategies adopted by the real combatants were at least as sensible as the many other approaches they would have been physically capable of pursuing, this is a comforting indication that the simulation may have some merit as a model of the real conflict. If the historical actions are so clearly preferable that no rational player would ever do anything else, this has the added advantage of making it less likely that wargames in class will diverge too radically from historical precedent, but it also tends to reduce variations due to player skill and so makes the outcome of the contest proportionally more dependent on chance. Hence, designers usually aim to

create trade-offs and dilemmas that make certain alternative courses of action almost as attractive as those adopted in reality, especially where there was live debate at the time about the respective merits of the different options concerned.[18] The trouble with this approach is that it requires very delicate balancing of the pros and contras of the various alternatives, lest one emerge as clearly preferable. This is particularly hard in simple microgames that do not have the depth and detail needed to convey the subtleties involved and to make it hard for players to gauge the best option. As shown in Appendix 3, it is all too easy for luck to outweigh the skill and decision element in such microgames, especially where a few crucial combat die rolls can have a disproportionate influence on the engagement as a whole.[19] However, as long as random variation is not so great that players can prevail even if they adopt palpably inferior strategies (such as fighting on heroically at Dunkirk instead of evacuating as many troops as possible to defend the UK), the game will still teach important lessons about the dynamics of the real conflict.

If a wargame causes players always to choose different tactics and strategies from those followed historically, then it clearly fails as a simulation, since it will never come close to mirroring the actual course of events. In this instance, designers must ask whether the apparent inferiority of the historical strategy is an artefact of a flawed game system (which they hence need to correct), or whether there are unmodelled factors such as poor intelligence, command weaknesses or political mandates that caused the adoption in reality of a militarily suboptimal approach. In the latter case, there are various ways of remedying the omission and so making historical choices more likely. In Chapter 7, I discussed the options of directly simulating the fog of war or of leaving one side entirely to AI control, and I showed the limitations of these techniques in the academic study of past conflicts. I will now explore more indirect ways of modelling historical constraints, while retaining the character of the simulation as an explicit working model of the real conflict, equally accessible to solitaire experimentation and to guided competition in class.

The simplest way of preventing players from making attractive but ahistorical choices is to forbid such choices altogether. Sometimes certain choices can be ‘designed out’ within the game

system itself, as in simulations of the Soviet counteroffensive at Stalingrad that start on the day of the attack and give the Soviets the first player turn, thereby leaving the Germans no chance either to reinforce the weak flanks or to withdraw the 6th Army before it is too late.[20] On other occasions, special rules may be needed to reflect particular constraints, as in the politically driven 'Axis Allied' rules in Eastern Front simulations, which limit advances by Finnish troops beyond their 1939 borders, forbid units from Hitler's Balkan allies being used too far north and prevent Rumanian and Hungarian units operating together because of their historical antagonism.[21] Such special rules work best when they act to prohibit certain actions while leaving the player free to do anything else with the units involved. When the need is instead to *mandate* certain actions (such as forcing units to attack or advance against the better judgement of the player), it is much harder to frame the rules in ways that will not produce ahistorical results as players observe the letter but not the spirit of the constraints concerned. Tempting the Russians and Austrians to advance off the Pratzen Heights at Austerlitz, or tempting the Soviets to overextend their advance at Kharkov in early 1943 and so leave themselves vulnerable to Manstein's counterblow, are examples where mandatory constraints find it hard to simulate the overconfidence that prevailed in reality.[22] Players also understandably dislike 'iron maiden' rules that limit their flexibility, force them to act in evidently irrational ways, and dilute the very human insights that distinguish wargames from mere mathematical equations.

The other way of encouraging historical strategies is to use carrots rather than sticks. Although wargame designers do not have the same absolute power as counterfactual historians do to shape simulated events according to their whim, they do have the crucial ability to set the objectives that determine player victory and defeat within the artificial game universe they create. This allows them to encourage almost any desired behaviour, however militarily questionable, by setting game rewards accordingly. For example, in many conflicts it is clear in hindsight that one side was overmatched and was bound to be defeated if it tried to stand its ground, so a more rational game strategy would be to retreat from the outset and so preserve force strength instead of suffering

pointless losses defending ultimately indefensible terrain. However, if the designer creates victory conditions that rule that the superior side wins if it has captured a certain number of towns or cities by the end of any turn and if the required victory threshold starts off low and increases steadily from turn to turn, then the defenders have a much clearer incentive to conduct a gradual fighting retreat and to trade strength for space and time.[23] Some designers apply this principle to both sides and rule that the game will end if the victory level diverges too far in either direction from historical reality at the end of any turn – they then reduce the acceptable divergence from turn to turn to create a narrowing funnel that will automatically decide the contest sooner or later. This system has the advantage that games swinging heavily in one side's favour need not be dragged out to the bitter end.[24]

As these examples illustrate, wargame victory conditions tend to be based not simply on which side prevails in absolute, real-world terms, but more on which side does better relative to the historical outcome of the contest.[25] Figure 4.1 shows that the distribution of game outcomes need not be symmetrical or centred around the historical result, and many simulations treat a recurrence of the historical outcome not as a game draw but as a narrow victory for one side. However, in more one-sided contests, handicapping provisions come into play in earnest, and it is not unknown for a greatly superior side to be deemed to have lost the game if it has a single unit destroyed or if a single enemy unit manages to remain on the map.[26] The concept of 'game victory' as distinct from real-world victory is most problematic in ancient battles, where the proverbial 'Pyrrhic victories' were actually the exception, and where fleeing armies could suffer a hundred times as many losses as their opponents.[27] However, even here (as my *Lost Battles* system shows) it is possible to devise a workable handicapping system using asymmetric victory conditions, and this is certainly preferable in simulation terms to the approach used in some other ancient wargames that achieve game balance by artificially equalising the two sides' chances of gaining a real battlefield victory.[28]

Because of their direct impact on player behaviour, victory conditions are just as crucial for effective overall simulation as are

the rules for movement and combat, and they face exactly the same tension between accuracy and simplicity (as I discussed in Chapter 2). As with movement and combat rules, victory conditions revolve around the three constituent elements of force, space and time. Chess has an entirely force-based victory rule focused on taking the enemy king, although with a provision for stalemate if the contest becomes deadlocked. Wargames sometimes have a similar rule that the loss of a key leader such as Hannibal or Napoleon automatically decides the game, but this is usually only a supplement to the main victory conditions.[29] The simplest wargame victory rules tend to focus on the occupation of one or more key locations at the end of the game – for example, one way of deciding a two- or three-player simulation of World War Two in Europe is to rule that whichever side occupies Berlin at the end of the spring 1945 turn wins.[30] The trouble with such straightforward determinants is that everything else tends to be subordinated ruthlessly to the achievement of this single goal (especially in the final turns), thereby dragging forces away from other historical fronts such as the fighting around Budapest and in Courland as well as in Italy and along the Rhine in the last months of the war.[31] Increasing the number of different locations that count for victory helps to encourage more balanced and variable strategies, but it requires some means of comparing the value of different objectives.

The standard approach is to create a common currency of 'victory points'. Each objective may then be assigned a victory point value, and the winner may be determined based on the overall number of points accumulated.[32] This system also allows points to be awarded for each turn an objective is occupied rather than just at the end of the game, thereby giving a more subtle reflection of the time dimension as I discussed earlier.[33] To prevent forces being sacrificed (especially in the final turns) to attack or defend key objectives, the same points system may be extended to reward players for destroying or damaging enemy units, with some units being more valuable than others. Designers can decide exactly how to balance victory points for holding territory and for inflicting losses, hence determining the relative priority players will place on these two objectives. In some cases (particularly in air

and naval simulations), territory will be valueless in itself and only the relative losses of the two forces will matter, thereby encouraging swirling contests of manoeuvre.[34] In tactical simulations of land battles, some designers award victory points for holding minor terrain features such as the Peach Orchard, Devil's Den and Little Round Top at Gettysburg (on the grounds that these features were invested with great significance during the actual fighting), while other designers focus more on force losses (on the grounds that the terrain is of little intrinsic value and the fighting could easily have developed somewhere else).[35] Which of these approaches is more appropriate depends on the scale of the simulation and on whether the combat system revolves more around retreats or unit attrition – if the former, then terrain-based victory points may be the only way to persuade players to stand and suffer the historical losses. Victory points can also be used to reward players for specific actions such as conducting politically mandated attacks.[36] Overall, there is almost no limit to the possible subtlety and complexity of victory point systems, and the challenge as usual is to keep things as simple as possible while exploiting the potential of the system to mirror the complex web of motivations that influence the real antagonists.

Although the map and counters are the most visible and distinctive components of a wargame, the most important component by far is the rules booklet. It is the rules that enshrine all the many concepts I have discussed throughout Part II, and that weave them together into a coherent game system to be understood and played by people who have never met the designer. Perla argues that 'Wargaming is an act of communication' and this is nowhere more true than in the drafting of the game rules.[37] The task is a cross between producing an academic analysis, drawing up a legal contract, and writing a computer program. It requires a systematic approach, logical thought, clarity of expression, and constant crosschecking. Unlike with traditional academic essays, which are usually written only towards the end of a research project, wargame rules will evolve throughout the process, with a profusion of different concepts being tried out, modified or discarded as the designer's ideas develop over time. The challenge is so difficult that it is very much

the exception rather than the norm even for published wargame rules to achieve the level of clarity and accuracy required. Designers routinely produce errata sheets in response to problems highlighted by players after publication and wargame companies now exploit the internet to offer electronic 'living rules' that are updated successively to address the glitches that arise (just as computer programs have their bugs ironed out through a series of downloadable 'patches').[38] The more complex and detailed the game system, the more vulnerable it tends to be to such difficulties, and there are some wargames for which the errata alone exceed the length of the entire rules in more traditional board games.[39]

Just as wargame systems face a difficult trade-off between accuracy and simplicity, so wargame rules face a similar trade-off between length and comprehensiveness. Some designers try to keep their rules as short and concise as possible in order to avoid putting players off, while others prefer to explain points clearly and repeatedly and to include plenty of examples and illustrations, even though this means that the booklet extends over many more pages.[40] Designers often try to achieve the best of both worlds by dividing the booklet into successive chunks such as Basic, Advanced and Optional Rules, and they sometimes go even further by cramming Introductory Rules onto a single (albeit large and closely typed) sheet.[41] One factor affecting rules length is how much should be left to players' 'common sense'. It is tempting to take certain things for granted (such as that units occupy hexes, cannot skip hexes during movement, and exert ZOCs even into enemy-occupied hexes), but these basics can cause great confusion among newcomers. Deliberately concise rules also often fail to define explicitly certain key nuances (such as how the fact that units must stop when moved adjacent to the enemy affects units that start their turn in such a position) and this can be very frustrating even for experienced wargamers.[42] Another influence on rules length is whether the designer chooses to state each rule just once or to repeat it under every section in which players might look (for instance by laying out the effect of ZOCs on movement in both the ZOC and the movement sections of the rules). Single mentions often cause players to miss key rules or to spend a lot of

time hunting for a rule ‘they know they saw somewhere’, while duplication makes it an even longer and more difficult task to try to absorb the lengthy rules in the first place.

Key to effective rules writing is breaking down the overall game system into a logical succession of clearly signposted elements, which can then be laid out in turn. Most rules start with a general introduction to the map and the unit counters, and then proceed through a fairly standard array of sections such as ‘Setup’, ‘Sequence of Play’, ‘Movement’, ‘Combat’, and ‘Victory’. These sections may be supplemented by others such as ‘Command’, ‘Stacking’, ‘Zones of Control’, ‘Supply’, ‘Morale’, ‘Reinforcement’ and ‘Production’, depending on the particular conflict and game system concerned, and there are also often separate sections for supporting forces such as ‘Artillery’, ‘Sea Power’ and ‘Air Power’.[43] Each section is usually divided into subsections, each with its own subheading and listing on the contents page so as to make finding the appropriate rule easier. Some designers go further and use a hierarchy of numbered paragraphs, as in David Isby’s ultra-complex 1977 simulation *Air War*, in which rule 20.13 on the search arcs of Type A radar is part of subsection 20.1 on search arcs, itself part of section 20 on radar search.[44] This format can be rather legalistic and off-putting, but it does have the advantage of making cross-references easier without needing to restate rules in full.[45] The rules are usually supplemented by one or more charts such as the ‘Combat Results Table’ or ‘Terrain Effects Chart’ and these are often placed on unused sections of the mapsheet or else printed on separate cards for ready reference during play. One recent solitaire game of B-29 operations in 1944–45 contains no fewer than 73 different tables and charts to cover the various eventualities that might occur, and they fill a booklet twice as long as the rules booklet itself![46]

Many wargames use the same basic rules to cover multiple ‘scenarios’ (as in my previous book *Lost Battles*, which develops a common rules system allowing players to refight 35 different ancient land engagements and to devise their own scenarios for other battles not covered in the book).[47] Sometimes extra scenarios are just subsets of the main simulation, covering shorter periods or more restricted areas of the fighting, or incorporating

specific counterfactual variations such as changes to the orders of battle or reinforcement schedule.[48] In other cases, the same 'series rules' may be applied to multiple conflicts, each with their own map and counters. These multiple battles may be packaged within the same game (as in the SPI 'quad games' of the 1970s), or each simulation may be published separately, providing the latest edition of the series rules together with a separate booklet of special rules and scenario-specific instructions such as setup details and victory conditions.[49] Using the same basic rules to cover multiple scenarios saves development time, allows players to explore different conflicts or different aspects of the same conflict without absorbing new rules each time and facilitates the incorporation of comparative evidence as I discussed in Chapter 4 (since designers are forced to base their system on wider considerations than just a single engagement). The downside of the series rules approach is that if the rules try to be comprehensive they will have to include lots of dimensions that are not applicable in some individual scenarios, while if they restrict themselves only to universal aspects, each scenario will need to have extensive special rules that may include a confusing list of modifications and exceptions to the core system. Series rules may also act as something of a straitjacket, and may inhibit designers from applying tailored simulation responses to significant differences in scale, technology or circumstances among individual scenarios.[50]

By far the most common failing of wargames rules is that they do not provide a clear and unambiguous exposition of all aspects of the system. This may be because certain key nuances are not set out explicitly at all, leaving players to guess what should be done in those circumstances. However, even more confusing are the many cases in which the rules and charts do give explicit instructions, but where different rules sections contain inconsistent statements on the point concerned, presenting players with a dilemma over which section is correct. Such inconsistencies arise all too easily as rules evolve during the design process, since there is a constant risk of designers updating one section while forgetting to update other references to the same point. The more individual subsystems the rules contain, the more complex and multifarious

will be the interactions among them, and hence the greater the risk that designers will either fail to discuss certain interactions altogether or will give inconsistent instructions in the different rules sections. It takes a combination of logical thinking through of all possible interactions and very careful proofreading of the final rules draft to minimise these common problems and so to produce rules that allow the simulation to be played without any further input from the designer. The simpler the game system and the more careful and conscientious the designer, the greater the chance that this ideal will be achieved.

It is very difficult for players to grasp a system purely from abstract statements of theoretical principles, so supplementing the rules with concrete examples of play offers a very important way of making wargames more accessible. Some wargames incorporate separate examples of each subsystem such as movement and combat (usually in the form of successive 'asides' within the rules themselves), while other games provide a single longer and more composite example such as a separate description of a complete sample game turn.[51] The former approach makes it easier to grasp each subsystem in isolation, while the latter approach allows better coverage of the crucial interactions among the subsystems. In either case, graphical illustrations give the examples much greater clarity and impact, while a careful choice of situations allows detailed nuances to be explained as well as more routine and straightforward mechanisms. The detailed examples of play that I provide in Part III are of crucial importance in clarifying the operation of the systems involved. Just as the first duty of a hospital is not to spread disease, so the first duty of an example is not to *increase* player confusion. Examples should only ever illustrate precepts that have already been covered in the rules themselves (rather than providing an independent source of rules exposition), and the worst sin that an example can commit is to contradict a correctly stated rule.[52] It is hence best to delay producing examples until the rules themselves have been finalised, lest the examples preserve misleading fossilised records of earlier ideas.

Many published wargames save on production costs by including little text except for the rules and a few very brief examples of play, but others supplement this essential core with

varying amounts of commentary by the designer or developer.[53] Such designer's notes are invaluable when using wargames to give academic insights, and I insist my MA students devote at least as many words to this supporting commentary as to the rules and examples themselves. My previous book *Lost Battles* goes even further, by using fewer than 60 of its 330 pages of text and illustrations to provide the rules, examples and scenario details needed to play the simulations – the rest is spent on detailed historical and design discussions and extensive scholarly references.[54] This shows the amount of thought and research needed to underpin conflict simulations, even though commercial pressures preclude anything like such a heavy emphasis on commentary and evidence in games published for the hobby market. Some wargames integrate design notes into the relevant sections of the rules, but this adds to the length and unwieldiness of the instructions, so a more common approach is to separate the two (and sometimes even to publish the design notes online or in hobby journals rather than in the game itself).[55] Wargames often also include players' notes giving hints on the best strategies for each side to adopt – this does risk depriving players of the interest of exploring different strategies for themselves, but it also helps to avoid the blighting of initial contests by inexperience.[56] As I discussed in Chapter 7, direct simulation of the mistakes that the real commanders made first time round is highly problematic because of the influence of hindsight, and since students only have time for a single refight at most, it is often better to use 'guided competition' to save them from making basic errors that would distort the entire course of the 'working model' they are exploring.

Even simple wargames are far too complex for designers to be able to anticipate on a purely theoretical basis the overall outcome that the interaction of the various subsystems and the multiple units will produce, especially when combined with the unpredictable decisions of competing players. Hence, designers need to test their evolving games repeatedly, by playing them to see what impact each successive change may have. As discussed in Chapters 2 and 7, lengthy playing times and direct simulation of asymmetric knowledge are both severe liabilities when trying to develop an accurate model, since they hinder the process of trial

and error that lies at the heart of the design endeavour. Because of the variability of individual contests (as portrayed graphically in Figure 4.1), designers actually need to play each version multiple times if they are to get a representative sense of the likely course and outcome of the simulation. While I was designing the games described in Part III, I played and recorded dozens of contests in order to obtain just such an overview of how the systems worked in practice. From experimenting with individual subsystems to making fine adjustments to the overall product, playtesting is a key ingredient of the design process and designers themselves are by far the most important playtesters.

Once wargame designs reach a certain stage, it is also important for other people to become involved. Commercial wargame companies have a tried and tested process in which a designer's initial draft is passed to a developer for refinement, drawing on reports from teams of playtesters. With graphic design also delegated to a professional artist, the published game is hence very much a collective rather than an individual endeavour and (in stark contrast to books) it is common for the designer's name not even to appear on the cover.[57] In my MA course, considerations of time, resources and individual assessment require that designers assume a more pivotal role throughout, but playtesting by other students still plays a key part, and I myself give lots of detailed advice as the projects evolve. My own wargames in this book, just like those in *Lost Battles*, have benefited from years of feedback and playtest experience involving a wide variety of individuals, and designing simulations for academic and educational purposes is very much an interactive and evolutionary process as one strives to improve clarity and to strike the best balance between accuracy and simplicity.[58] In one of our classes, Charles Vasey made the very accurate observation that wargame designs are never truly finished, only abandoned.

Getting other people to play a wargame offers several benefits that are unobtainable simply by testing it more intensively and proofreading it more assiduously oneself. First, the others are more likely to spot rules ambiguities where the designer has simply taken for granted one 'obvious' interpretation. Second, other players will probably take a lot longer than the designer to complete a game, and will find the rules complexities harder to

grasp, thereby giving a much more realistic sense of how small and simple the simulation needs to be to make it viable and accessible for employment in class. Third, other people will be less likely than the designer to fall into stereotyped patterns of play, often corresponding to the strategies adopted by the real antagonists – they will instead pursue different strategies that may have been too readily dismissed by the more expert designer as 'clearly inferior', and that may either unbalance and distort the whole simulation or in some cases turn out to offer a better (although perhaps unrealistic) route to game victory than the preferred historical approach. All these insights will be maximised in the case of 'blind' playtesting where the designer is not even present to explain and correct, although this extreme approach makes it harder for the designer to see what is going wrong, and it increases the risk that a single initial mistake will go uncorrected and so devalue the whole of the subsequent playtest. For commercial wargames where the whole point is to publish something that people across the world can play with no other input from the designer, blind playtesting is an essential safeguard against discovering fundamental problems only when it is too late, but for educational wargames in which an expert facilitator is present throughout, my experience is that the tensions are rather less severe, and that systems that non-wargamers would not even attempt to tackle on their own can be played in class with reasonable speed and fidelity through the technique of guided competition.

For professional wargamers, a key concern is 'validation', since that is the only way in which they can convince often sceptical officers and officials that their artificial games bear any useful relationship to the real world security problems that need to be faced.[59] Great pains are taken to incorporate advice from officers with real combat experience, and to demonstrate that the games can faithfully mirror at least some selected features of real observed conflicts. Recreational wargames have a rather more ambivalent relationship with the whole process of validation. On the one hand, checking the games against reality should, in principle, be far easier, since most hobby wargames simulate historical conflicts whereas most professional simulations focus more on potential future conflicts whose possible course is far

harder to discern. On the other hand, since recreational games are played primarily for enjoyment rather than academic enlightenment and are shaped by commercial rather than professional considerations, the pressure for formal validation of the design process is much weaker. Some hobby wargamers, such as Bill Haggart, have argued that professional approaches to simulation and validation can and should be applied to purportedly historical wargames: 'This isn't any more complex or expensive to do than what designers are providing in their games now – just different.'[60] Other wargamers, however, take a different view. Charles Vasey described Haggart's approach as 'what the French would call "sérieux"; his aim being to render his hobby valid in the opinions of his historically minded acquaintances'. Vasey went on to say: 'I do not feel any such need nor do I accept his "recreation" definition … It seems to me that it is entirely possible to have a historical wargame without following the Haggart validation process.'[61]

Given my own belief that wargaming techniques can indeed serve as a useful vehicle for academic insights into past conflicts, it will scarcely be a surprise that I do think that certain forms of validation are entirely appropriate. This is in line with the great majority of wargame reviews in hobby magazines, which discuss the historical accuracy of simulation designs and not just how enjoyable a game they provide.[62] It is often thought that accuracy requires detail and complexity, but one of Haggart's most important points is that: 'Simulations aren't dependent on the number of facts in them. The quality of a simulation is determined by how well it reproduces the real world dynamics the designer has chosen to portray, not how many. The amount of data in it isn't a measure of a simulation's quality – what the simulation does during play is the quality issue, and the data only support that effort.'[63] The key point here is that abstraction and indirect simulation of certain aspects of a conflict are perfectly acceptable, in order to allow a simpler and more accessible focus on other aspects – this is exactly what I argued in Chapter 7 with regard to indirect modelling of command dynamics and the fog of war.[64] From this perspective, disagreements like those between Haggart and Vasey are not really about validation at all, but rather about which aspects of reality the simulation should emphasise – Vasey prefers to focus

on creating a decision experience similar to that of the real commanders, which is why he advocates ‘chaos gaming’, uncertainty, and the incorporation of radical variations that make it very unlikely that any contest will follow a slavishly historical path.[65]

In my own wargames, where the focus is instead on creating interactive working models of the strategic and tactical dynamics of past conflicts, validation essentially boils down to three basic questions.[66] These questions are as follows:

- If both sides take the same actions as they did historically, does the game system tend to yield a broadly similar course and outcome for the conflict as occurred in reality?
- If players exercise rational choices to maximise their chance of game victory, do their strategies at least sometimes match those of the real antagonists?
- Do the game system and scenario plausibly reflect what we know of the characteristics and underlying dynamics of the historical struggle, either through direct simulation or through more abstract and indirect mechanisms that nevertheless capture the most basic elements of reality?

The third test is the most difficult one to apply, and it is probably best conducted by introducing extreme variations such as doubling the strength of one side, removing a key general, or conducting a totally different strategy, and seeing if this has anything like the same effect in the game as one can reasonably deduce it would have had in real life. It is much easier to see how all this works with reference to specific cases than in terms of abstract principles, so I will now at last proceed to discuss the individual simulations which I have designed over the past 20 years, and explain how I use them to support my teaching and research on various aspects of the history of warfare.

PART III

Examples

9

Ancient warfare

In 1977 Charles Starks satirised the trend towards ever greater detail and complexity in conflict simulations by imagining ‘The Ultimate Wargame’, which would simulate the whole of World War Two using hundreds of volumes of rules and a separate counter for each person involved.[1] As I write, I have just returned from giving a keynote address on my simulation techniques at a conference in Canada on ‘Archaeology and Warfare’. The other visiting speaker at the conference was eminent Byzantinist John Haldon from Princeton University, and he described his involvement in a major interdisciplinary research project to create a dynamic computer model of the logistics of the Manzikert campaign in ad1071, with every single one of the tens of thousands of troops represented as a separate ‘agent’ with its own distinctive attributes such as rank, location, health, range of vision, and with its own ability to undertake actions such as foraging for supplies within the finely detailed local environment.[2] This real model is obviously far less ambitious and complex than Starks’s fantasy, but it still needs to be run using ‘distributed simulation’ across a network of computers, since the calculations involved are much too intensive to be handled by a single machine.

In Chapter 2, I discussed the tendency for computer programmers to focus on ‘bottom up’ simulations of all the detailed ingredients of a conflict, and I showed how the theoretical accuracy and objectivity of such simulations may be severely undermined if they focus unduly on quantifiable technicalities and not on the much less calculable impact of human decisions and psychology. More ‘top down’ models based on observed outputs rather than theoretical inputs are often at least as successful in capturing the essence of particular contests. That said, it is rather

unsatisfactory for low-level interactions within any wargame to be resolved simply by the designer's *fiat* as to the likely range of outcomes in each case, since this bolsters the idea that the games are based mainly on guesswork and impressionistic subjectivity.[3] There is thus a constant temptation to incorporate less abstract and more detailed direct simulation of the processes at work, and this helps to explain why published wargames tend to be so large and complex. To arrest the drift towards unplayable levels of detail and complexity that usually occurs within a single game model, I myself tend to use multiple separate simulations that together make up a kind of 'nested set', with the dynamics of each game informing and underpinning the much more abstract treatment of the phenomena concerned at the next higher level. The process is rather like zooming out within Google Earth from a view of one's own house to a view of the entire planet – at each stage, the image has a constant number of pixels, as detail is progressively traded for breadth of coverage.

The best example of such a nested set of simulations comes from my work on ancient warfare. In my third year BA course on the subject, I now use no fewer than five different levels of modelling to capture the dynamics of the contests concerned. At the broadest, grand strategic level, we employ my 2009 game *Empire*, which allows the two centuries from 350 to 150bc to be recreated in just half an hour using turns representing a decade each, and which is so simple that students can be left to run simultaneous four player contests for themselves, with each player guiding the destiny of Carthage, Rome, Macedon or Persia/Parthia as they contend for dominance.[4] The simulation highlights the enormous surges of military activity associated with 'great captains' such as Alexander, Hannibal and Scipio, and by limiting each empire without a great captain to just one major campaign per turn and having one random province somewhere on the board become independent every turn, it models the way in which large empires progressively became more and more hamstrung by internal revolts and civil wars.[5] Random variation plays a large part in shaping the course of events (as is common in really simple games), but the players also face difficult trade-offs as I outlined in Chapter 8, such as whether Carthage should

focus on expanding its empire in Spain or seek to shield the home city by the harder task of conquering Sicily.[6]

Having obtained an overview from the grand strategic level, we zoom in to study in more detail the epic contest of the Second Punic War from 218 to 201bc, in which the dynamic leadership of Hannibal and Scipio produced an intense succession of back-and-forth campaigns. We do this using two separate simulations at different levels – my own hitherto unpublished multiplayer strategic wargame of the entire *Second Punic War*, in which each turn represents two years of fighting, and a more detailed operational simulation of the first two years of Hannibal's Italian campaign from autumn 218 to autumn 216bc, in which each turn represents just ten to fifteen days. This second wargame, *Roma Invicta?*, was designed by my student Garrett Mills in 2007 as his project within my MA course on conflict simulation, and I subsequently redesigned it and published it under our joint authorship the following year.[7] I have included full revised versions of both of these simulations in the present chapter, since they provide very good illustrations of how one may incorporate complex political factors within wargame models.

The fourth level down in the nested set of simulations is provided, of course, by my grand tactical system *Lost Battles* (in which each turn represents ten to 40 minutes).[8] I use this book throughout the BA course to cast light on the various engagements across the five centuries we cover, and the students spend one entire class in two parallel refights of Hannibal's classic victory at Cannae in 216bc, to gain a vivid sense of the interaction between force, space, time and command in ancient land battles and how superior generalship and battlefield manoeuvre could defeat even massive numbers of formidable troops such as Roman legionaries.[9] As I mentioned in Chapter 4, we recently published a deluxe combined edition of *Empire* and *Lost Battles*, including large mounted maps and die-cut counters, so together with the other two simulations laid out in the present chapter, all four of my ancient wargames are now readily available for readers to try for themselves.[10]

The fifth and final level of modelling that we use is not actually a wargame but rather a logical reconstruction of the low-level

dynamics of ancient infantry *melée*, based on my various studies over the last fifteen years on 'the face of Roman battle'.[11] As I mentioned in Chapter 4, I argue that the combination of long duration and low mutual casualties in infantry combat before one side broke and ran fits much better with a model of sporadic clashes separated by long intervals of short-range standoff, rather than the alternative images of continuous shoving or frontal duelling or the absurd Hollywood portrayals of intermingled bloody mayhem.[12] Although I have not translated this model into a playable wargame, it is based on exactly the same processes of logical analysis, and I do use a succession of photos of hundreds of miniature figures to provide a vivid one-to-one scale portrayal of how the model might operate in the case of a clash between a Celtic horde and several maniples of Roman legionaries in their distinctive chequerboard array.

Now that I have described the overall context of nested simulations that I employ in my ancient warfare teaching and research, I will provide complete illustrative details of the second and third games in the hierarchy. The idea of publishing a board wargame within a book (as opposed to a magazine) is not entirely new.[13] Dunnigan's *Complete Wargames Handbook* includes a microgame on *The Drive on Metz* in September 1944, with 20 counters and a 9 by 11 hex map to be photocopied and used.[14] Jeff Johnson's similarly sized microgame on the obscure 1527 battle of *Kassala* in Ethiopia was published within a wargames book produced in 1980 by the editors of *Consumer Guide*, and Nicholas Palmer included a full copy of Dunnigan's abstract introductory game *Strike Force One* in a sleeve at the back of his 1977 *Comprehensive Guide to Board Wargaming*.[15] I remember discussing with US Air Force wargames expert Matt Caffrey in the early 1990s the idea of a more conventional military history book that would include a wargame allowing readers to refight the actions described, and I finally put this innovative idea into practice in my *Lost Battles* book a few years ago.[16] However, due to the severe logistic difficulties of including game components within a traditional book, readers still had to download and print out for themselves the map and counters, and it was only through the recent publication of the deluxe boardgame edition of *Lost*

Battles that this deficiency was resolved.[17] The present book at last presents a true combined product, by using the colour plates to provide full colour components for several different microgames, which may be assembled as explained in Appendix 1.

My first illustrative simulation does not actually need these components, since it is a multiplayer game for use in class, requiring only a blackboard or whiteboard, a few different colours of pen or chalk, and a set of name badges. The game is for between ten and eighteen students, and it lasts up to 90 minutes including an initial explanation of the rules. As I said, it covers the *Second Punic War* from 218 to 201bc and I designed it to highlight for my students the deeply political nature of this classic bipolar struggle between Rome and Carthage.[18] In the end, Rome won not so much because of its military or resource superiority but because it was able to maintain greater commitment and unity of effort from its citizens, subjects and allies when things looked black than Carthage proved able to do in similar circumstances. Hence, the Roman confederacy did not fall apart in spite of Hannibal's tremendous initial victories in Italy, whereas the Punic Senate failed to reinforce Hannibal's success, and Spanish and Numidian defections later played a key role in the triumph of Scipio's counteroffensives.[19]

To illustrate the deeply political character of the struggle, I decided to blend wargaming and role-playing techniques by giving each student an individual role with its own specific victory objectives, based on the motivations that guided the different factions and peoples in the real conflict. The game is played in up to nine turns (each representing two years), and in each turn, each player may decide whether or not to mobilise an army and, in some cases, for which side. Mobilising an army generally costs a victory point to reflect the disruption to normal agricultural activity, but the incentive to do so regardless is that it may offer tribal peoples benefits such as plunder, and that it may help secure a favourable outcome for the entire war from that faction's point of view. Some factions get victory points mainly if the enemy great power surrenders, while others get victory points mainly if their own great power avoids surrender – this distinction tends to

make the latter factions (such as the Fabii in Italy) ready to mobilise in defence of their homeland, but less keen to pay the costs of offensive operations to bring the war to a victorious conclusion. A more immediate incentive is that whichever side has the larger army in a region at the end of a turn may ravage the lands of all opposing or passive factions based there, so costing those factions a victory point. This creates the conditions for some wonderful diplomatic negotiations (hence the faction name badges), which often involve beleaguered factions being threatened with ravaging by both sides if they do not choose a particular mobilisation option. The victory point awards also incorporate subtleties such as the Spanish preferring an unresolved conflict in which they can play one overlord off against the other, or the Gauls being a double-edged ally for Hannibal because they alienate the Italians just as Royalist use of Irish troops alienated protestant opinion during the British Civil Wars.[20]

Since the focus of the simulation is very much on the political dynamics, I keep the military side as abstract as possible. The entire theatre from Spain to Greece is divided into just five regions, and the only active units in the game are ‘armies’ that simply belong to Rome or Carthage (whichever faction originally mobilised them). I draw a very basic map on the board and draw or erase different coloured check marks for the armies as they are recruited, move or are destroyed. Each side has six armies that start out in their historical positions at the outset of the war, and they are supplemented by a continuing series of newly mobilised forces to offset the heavy attrition of campaigning (just as happened historically). Supply constraints are simulated by limiting Carthage to no more than five armies per region and Rome to no more than six armies per region (with the difference reflecting the logistic benefits of Roman naval superiority). Each side may move up to two armies per turn out of each region across sea passages, or three armies across land borders, but Rome moves its armies second in each turn, before combat is resolved. As discussed in Chapter 7, moving second is a key advantage, reflecting the naval and intelligence superiority which allowed Rome to seize the initiative as happened during the Metaurus campaign in 207bc.[21] Combat is an automatic process

in which I roll a die for each army and destroy an enemy army in the region on each roll of 5 or 6 (or 4, 5 or 6 in the open plains of Africa, where campaigns tended to be resolved more quickly). This gives the right average level of attritional loss, while the heavy random element produces some realistically one-sided engagements. Carthage surrenders if there is ever an unopposed Roman army in Africa, while Rome surrenders if there is ever an unopposed Punic army in either northern or southern Italy. This forces Rome to confront any invader with massive strength as it did throughout the war, but it also forces Carthage to defend Africa constantly in case of a sudden attack facilitated by Rome's crucial ability to move second.

Overall authority in the five regions is vested in three or four factions per side, with each faction controlling actions in one to three specific regions. The controlling faction decides whether to move armies out of that region and whether to ravage other factions based in the region, so there are often heated discussions between factions on each side as they try to implement a coordinated overall strategy despite their rather different individual interests. Instead of having decisions about mobilisation, movement and ravaging recorded secretly and simultaneously as in the simpler games described in Chapter 3 and Appendix 5, I go through each region and faction in a specific order and get the players concerned to call out their choices in turn. I have a teaching assistant record on the board the passage of turns, the shifting army positions and the changing victory point totals for each faction, thereby allowing me to focus on running the simulation. The only other key rule is that one Punic army is led by Hannibal, and one Roman army mobilised on turn five is led by Scipio the Younger. (The Scipionic faction raises its armies in Spain, as an abstract reflection of the Roman commitment there throughout the conflict.) The generals' armies achieve hits automatically, and survive enemy hits by forfeiting their own hits unless they are facing the enemy general. This reflects the way in which Hannibal was able to hold on with a small veteran force in the toe of Italy until he returned to Carthage voluntarily to face Scipio at Zama.[22]

The multiplayer nature of this game makes it hard to playtest fully, so the victory point awards offer only a very rough means of balancing the potential scores of the many factions. However, I have been playing successive versions of the game in my BA course for many years now, and it provides a very satisfactory and instructive class exercise. It is particularly good at illustrating how attack can be the best form of defence, as Hannibal jumps down the Roman throat into Italy itself while the Romans send forces to Spain so as to ‘fight where Hannibal is not’ and to pre-empt further reinforcement of the Carthaginian invasion forces. It also shows how disgruntled subjects can be cowed into passivity by the threat of retribution unless an opposing army arrives to ‘liberate’ them. Players often end up with a negative victory point total, showing very clearly how combatants can be ‘sucked in’ to a drawn-out conflict, constantly raising new forces in the hope that one final effort will at last tip the balance and provide the payoff they seek. I will now present the formal rules of the simulation, so that you may get a sense of how such rules may be drafted, and so that you may run a variant of the game in your own classes if desired.

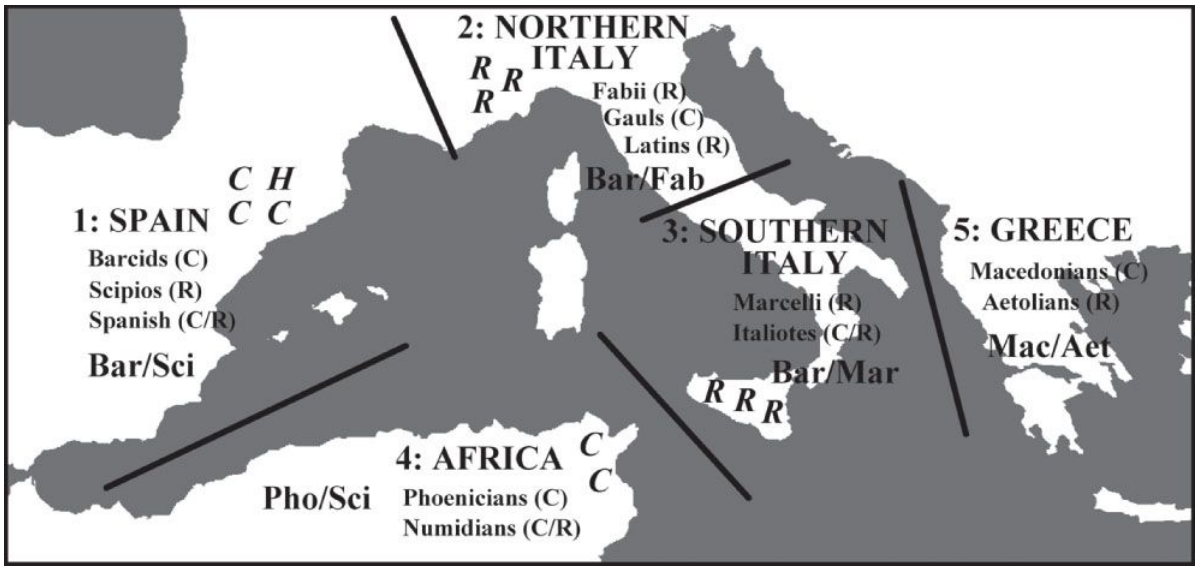
SECOND PUNIC WAR

INTRODUCTION

This is a multiplayer political simulation of the Second Punic War. Twelve players assume the roles of various factions, which decide policies and negotiate with one another in an attempt to achieve their individual objectives (measured by gains or losses of victory points). If there are only ten players, Greece may be left out of the game, along with the Macedonian and Aetolian factions. If there are more than twelve players, two players may share command of certain factions, starting with the main ones such as the Barcids and Scipios.

THE MAP

Action takes place on a map divided into five regions, as shown in Figure 9.1. Each region neighbours one, two or three other regions, as shown by the border lines between adjoining regions. Each faction has its base in a specific region, as illustrated on the map. In addition, four Roman and three Carthaginian factions play a strategic role by deciding on movement and ravaging within their base region and perhaps one or two other regions. Which factions make these decisions in each region is shown by the large initials in that region, with the Punic faction shown before the slash and the Roman faction after the slash. The abbreviations ‘Bar’, ‘Pho’ and ‘Mac’ stand for the Barcids, Phoenicians and Macedonians respectively, while the abbreviations ‘Sci’, ‘Fab’, ‘Mar’ and ‘Aet’ stand for the Scipios, Fabii, Marcelli and Aetolians respectively.



9.1 *Second Punic War* map

ARMIES

The war is fought by varying numbers of Roman and Carthaginian armies. Each army always occupies a specific region at any given time. Each side starts the game with six armies, deployed as shown by the italicised letters ‘C’, ‘H’ and ‘R’ in Figure 9.1. Armies may be moved between neighbouring regions, destroyed in combat, or raised by factions based in that region. The total number of armies in play is unconstrained, except that there may never be more than five Punic and/or six Roman armies in a single region at any time. If excess armies are moved into or raised in the region, they are immediately lost to attrition and disease.

SEQUENCE OF PLAY

After a short time for initial negotiations among the players, the simulation runs for up to nine turns, each representing two years of real time from 218bc to 201bc. Each turn proceeds through five phases:

1 Carthaginian movement phase
2 Roman movement phase
3 allegiance and recruitment phase
4 combat phase
5 ravaging phase.

MOVEMENT

During each side's movement phase, friendly armies may be moved out of each region in turn, in the order shown by the region numbers in Figure 9.1. The controlling faction for each region decides whether and how friendly armies move out of that region. A maximum of two friendly armies may move out of each region per turn, either in the same or in different directions. This maximum is raised to three if at least one army moves to or from northern Italy (across either border). Armies may move only to regions that neighbour the starting region. Armies which move may not move again that turn.

ALLEGIANCE AND RECRUITMENT

At the start of each allegiance and recruitment phase, players may spend a short time negotiating with any other factions desired. Then, each faction declares its stance for the turn, in region order and in the order in which the factions are listed within each region (so starting with the Barcids in Spain and proceeding through to the Aetolians in Greece). Factions may either remain inactive that turn or raise an army. Figure 9.1 shows in brackets after each faction's name whether it can raise an army for Carthage or for Rome or for either one, at that player's discretion from turn to turn. Armies raised are immediately added to the region concerned. The Aetolians must remain inactive if no enemy army is in Greece.

COMBAT

In each combat phase, combat occurs automatically and in the usual region order in all regions containing both Roman and Punic armies. A die is rolled for every army in the region, needing a score of 4, 5 or 6 to hit in Africa, or 5 or 6 to hit in other regions. Once both sides have rolled, one army is removed from the region for every hit achieved by the enemy, with any excess hits being ignored.

RAVAGING

In each ravaging phase, players go through the regions in the usual order, and if one side has more armies in the region than do its opponents, that side’s controlling faction for the region may choose to ravage any or all factions in the region that remained inactive or raised an army for the enemy that turn. Which factions to ravage is entirely up to the controlling faction.

GENERALSHIP

One initial Punic army in Spain is led by Hannibal (shown by an ‘H’ rather than a ‘C’), and the first Roman army raised by the Scipios in Spain on or after turn five (210–209bc) is led by Scipio the Younger. The movement of these armies is still controlled by the appropriate faction for the region they are leaving, even if this is not the Barcids or Scipios respectively. Generals’ armies do not participate normally in combat; instead, one enemy army is removed automatically before it gets a chance to dice. If the remaining enemies still score enough hits to remove all the friendly armies including the general’s army, both it and the enemy army which it removed survive the combat after all. If both generals are in the same combat, then both armies instead fight normally (needing the standard die rolls to hit), and are permanently removed if the enemy achieve at least as many hits as there are friendly armies.

VICTORY

The simulation ends with a Carthaginian surrender at the instant there is a Roman army and no Punic army in Africa. It ends with a Roman surrender at the instant there is a Carthaginian army and no Roman army in northern Italy or in southern Italy. Otherwise, the contest ends at the conclusion of turn 9 (202–201bc). A running total must be kept throughout the game of the victory points accumulated or lost by each faction. When the game ends, closing victory point awards are made, and the final totals show how well or badly each faction has fared. Victory point awards are as follows:

minus 1 for each turn in which the faction's lands are ravaged.
minus 1 for each turn in which the faction raises an army for either side, except for the Spanish, Gauls and Latins if the region contains an enemy army.
+2 for the Phoenicians if Rome surrenders.
+4 for the Macedonians, Gauls and Italiotes if Rome surrenders.
+8 for the Barcids if Rome surrenders.
+2 for the Numidians if Rome does not surrender.
+4 for the Latins and Aetolians if Rome does not surrender.
+6 for the Marcelli and Scipios if Rome does not surrender.
+8 for the Fabii if Rome does not surrender.
+2 for the Spanish if neither Rome nor Carthage surrenders.
+2 for the Fabii if Carthage surrenders.
+4 for the Marcelli and Numidians if Carthage surrenders.
+8 for the Scipios if Carthage surrenders.
+2 for the Macedonians, Gauls and Italiotes if Carthage does not surrender.
+6 for the Phoenicians and Barcids if Carthage does not surrender.

EXAMPLE OF PLAY

Once the initial negotiations have been conducted, turn one begins with the Carthaginian movement phase. The Barcids in Spain decide to send the maximum force of three armies including Hannibal's army across the Alps into northern Italy. Since all these armies have already moved, they cannot move on into southern Italy this turn. The Phoenicians in Africa keep their armies in place to defend Carthage itself.

In the Roman movement phase, the Fabii in northern Italy face a difficult choice as the Scipios plead for an invasion of Spain to stem the flow of reinforcements to Hannibal. Bolstered by promises of aid from the Marcelli, the Fabii send one army across to Spain. The Marcelli in southern Italy could send two armies to invade Africa as per the original Roman strategy, but instead they move them to northern Italy to help confront Hannibal.

The allegiance and recruitment phase begins with further frenzied negotiations, after which the Barcids and Scipios both raise a new army in Spain at the cost of a victory point each. The Spanish have the luxury of supporting either antagonist without such a cost thanks to the promise of plunder, but since it is unclear yet which side poses most threat as a future hegemon, they remain neutral for the moment. In northern Italy, the Fabii pay a point to raise an army, after which the Gauls raise troops at no cost for their Carthaginian liberators and the Latins raise another Roman army at no cost in response, bringing the Roman force to the maximum of six armies. In southern Italy, the Marcelli pay a point to build a second army, while keeping the Italiotes inactive through the threat of ravaging. The Phoenicians in Africa pay a point and raise an army to bolster their defence, while cowing the Numidians into inactivity. In Greece, Macedon decides to remain inactive to see how Hannibal performs, so the Aetolians have no option but to do likewise.

The combat phase starts in Spain, with the two Roman armies rolling 1 and 5 and the two Carthaginian armies rolling 4 and 2, so one Punic army is removed. In northern Italy, the Carthaginian rolls of 5, 2 and 6, plus Hannibal's automatic hit, destroy three Roman armies at the Trebia and Lake Trasimene. The five Roman

armies left after Hannibal's hit roll 3, 2, 6, 4 and 1, and so remove just one Punic army in response. (Had they got really lucky and inflicted four or five hits, then Hannibal's army would have survived, but the Roman army it removed would have been revived.)

The ravaging phase starts in Spain, where the Romans now enjoy military superiority. The Scipios choose to ravage the Barcids, who lose another victory point, but they leave the inactive Spanish in peace since they do not want to alienate them as potential future allies. In northern Italy there is no ravaging, because neither side outnumbers the other. The Marcelli in southern Italy and the Phoenicians in Africa keep their promises to leave their subjects unravaged, and in Greece the fighting has not yet begun. This ends the first turn of the simulation.

Having used this simulation to study the political dynamics of the entire Second Punic war, we zoom in the following week for a more detailed operational level reconstruction of the most famous part of the conflict, namely the first two years of Hannibal's campaigns in Italy, which historically encompassed his three great victories at the River Trebia, Lake Trasimene and Cannae.[23] As I mentioned, this game was originally designed by one of my MA students, Garrett Mills, as his project in my conflict simulation module in 2006/07, so for it now to be used routinely as an exercise in my BA course on ancient warfare is perhaps the ultimate vindication of the educational value of simulation techniques. I made quite a lot of detailed changes for the version that we published under our joint names through the Society of Ancients in 2008, and the version that follows incorporates some further modifications and streamlining based on extensive playing experience since that time.[24] However, the essence of all the various mechanisms was already there in Garrett's original design, a major achievement given his lack of prior experience of simulation gaming.

As I have highlighted frequently in my more conventional academic writing on ancient warfare, a key feature of campaigns in this era was that open battles required a certain degree of mutual consent.[25] Not only could armies disinclined to engage the

enemy shelter behind city walls (as famously demonstrated by Pericles's strategy of avoiding battle with the main Spartan army during the Peloponnesian War), but even forces operating in the open country could deter attacks by more capable opponents by the simple expedient of sticking to high ground, thereby giving themselves a considerable defensive advantage in terms of the primitive weaponry of the time.[26] Perhaps the best illustration of such tactics comes from this very campaign, when Fabius 'Cunctator' (the Delayer) was able to march along parallel to Hannibal, and even to capture some of his foragers, without being drawn into accepting a pitched battle (thanks also to the routine Roman use of field fortifications to protect their camps).[27]

Just as important as the military practicality of such battle avoidance tactics is the political difficulty that states often had in implementing such a cautious and unheroic approach. Pericles nearly lost power through his break with the previous Greek tradition of deciding matters through a single climactic clash, and later ancient history is full of ill-advised acceptances of challenges to battle, from the Persians facing Alexander at the River Granicus to Pompey confronting Caesar at Pharsalus.[28] It was only the disasters suffered by more 'gung ho' generals at the Trebia and Lake Trasimene which persuaded the Romans to adopt Fabius's cautious tactics in the first place, and even after he had clearly demonstrated the effectiveness of his approach, the Senate soon became disenchanted and reverted to a more aggressive stance which culminated in the even greater catastrophe of Cannae.[29] Hence, our main aim in this simulation is to move beyond the very abstract handling of combat interactions in the previous model, and to confront players directly with the tangled military and political trade-offs associated with offering or refusing battle in this era.

Most published operational level wargames of this and other ancient campaigns use a fairly fine hexagon grid to model the detailed terrain and to show the location of individual cities, and they also tend to include lots of counters showing the different units within each army.[30] To keep things simple and to reduce playing time, we decided instead to divide Italy into just thirteen irregular regions divided by the River Po or the Apennine

mountains, and to leave cities out of the simulation altogether since the sieges of Capua and Tarentum postdated the faster moving *Blitzkrieg* campaigns of this initial era.[31] We also decided to dispense with separate counters for each individual unit, and instead to record the total strength of each army on a separate off-map track, differentiating troop types only in terms of the single dimension which Polybius highlights as by far the most important, namely the distinction between infantry and cavalry.[32] This allows us to track the strength of each army to the nearest 2000 infantry and 1000 horsemen, using just three counters per army. (Hannibal's famous elephants nearly all died in the first winter, and their impact is reflected abstractly within Hannibal's substantial combat bonus.)[33] Whereas other ancient wargames often have turns lasting an entire season or even longer, so as to cover wars that dragged on for decades, we chose to make our own simulation as interactive as possible by having each turn simulate just ten to fifteen days of action within the summer campaigning season, thereby allowing us to explore in more detail the action–reaction dynamics associated with seeking or avoiding battle.[34]

Our primary ancient sources (Polybius and Livy) give several 'snapshots' of the changing strength of the armies during the campaign, such as Polybius's claims that Hannibal had 20,000 infantry and 6000 cavalry on descending from the Alps, 29,000 infantry and 11,000 horsemen after receiving Gallic reinforcements in time for the battle of the Trebia shortly afterwards, and 40,000 infantry and 10,000 cavalry plus a few thousand men guarding the camp nearly two years later at Cannae.[35] There are some scholarly disputes about the ancient figures (especially over Polybius's claim that Rome fielded no fewer than 80,000 infantry and 6000 horsemen at Cannae), but in general they are seen as fairly reliable.[36] We have structured the reinforcement rates in the simulation such that troop numbers follow the historical pattern if losses match those which the ancient authors describe in the successive engagements. However, rather than making the massive Roman mobilisation automatic, we have made some of it contingent on the Romans actually suffering initial losses comparable to the bloodbath they underwent in reality. This helps to counter the impact of hindsight

and to make Roman players readier to engage Hannibal from the outset. Even so, one important research insight which the simulation provides is that, if Hannibal's army really was nearly 60,000 strong when it left Cisalpine Gaul in the campaign of 217bc (as is sometimes assumed by default), then it was crazy for Flaminius to pursue him with less than half as many troops.[37] We posit instead that Hannibal may have received further Celtic reinforcements during the following winter, to bring his force up to the strength recorded during the Cannae campaign.

In each turn, each army may move to a neighbouring region, attempt to ravage its existing region or confront an enemy army in the region. When an army tries to ravage the countryside or to move across a river or mountain pass, it may instead be forced to confront an enemy army seeking to block the action (as Fabius tried to block Hannibal's escape from devastated Campania to winter quarters in Samnium).[38] When an army is confronted, it may usually choose either to accept open combat or to take refuge behind fortifications or in broken terrain. If it does decline combat, the confronting army may then either break off the engagement or launch a bloody attritional assault in which only infantry count and the defender is at a significant advantage. If open combat is accepted, it may take the form either of a cavalry skirmish as at the Ticinus and the defeat of Centenius or a full pitched battle as at the Trebia and Cannae.[39] As I mentioned in Chapter 1, Lanchester was quite wrong to suggest that, because each side could only fit the same number of men into the fighting front, ancient battles would produce more balanced casualties than modern ones.[40] In fact, most of the killing seems to have occurred after one side broke and fled, and the asymmetry was particularly acute in this period, when cavalry allowed a vicious pursuit or could even encircle defeated forces altogether and hem them in for slaughter as at Cannae.[41] Our combat system reflects these dynamics and allows armies with superior cavalry and generalship to inflict realistically one-sided bloodbaths on their opponents. There is also a continuing risk that Roman generals less cautious than Fabius will blunder into a devastating ambush, as happened to Flaminius at Lake Trasimene and to the praetor

Postumius in Cisalpine Gaul just after the period of our simulation.[42]

So why would rational Roman players ever risk losing entire armies in such one-sided engagements? As I said, one consideration is that the Roman reinforcement rate is massive and actually increases with adversity, whereas Punic reinforcements are much less numerous and may dry up altogether if Hannibal's bandwagon fails to gather momentum, so there is a real incentive for the Romans to try to give the Carthaginians a bloody nose, even at disproportionate cost.[43] More fundamentally, our system tracks Roman demoralisation in terms of two distinct dimensions – military demoralisation (based on casualties inflicted and sustained) and prestige loss (accrued when Roman armies retreat or decline combat or when Roman territory is ravaged). The overall confidence of the Roman confederacy depends on whichever of these demoralisation levels is greater, and moreover, prestige losses accrue much faster once they outstrip the military loss level. This means that military disasters catapult the military loss level into the lead and allow Rome to adopt a more cautious approach for a while as prestige losses gradually catch up (as happened after the defeat at Lake Trasimene in 217 and again after the even greater catastrophe at Cannae in 216). The system thus has a self-stabilising character and most contests tend to end up (after months of sweeping manoeuvres and several epic engagements) with the combatants becoming bogged down in positional warfare in the valuable region of Campania, exactly as happened historically. The Romans lose prestige if they fail to contest Campania even after it has defected, to reflect their defence of isolated towns there which remained loyal.[44]

A week before the class, I lend my BA students the rules booklet from the 2008 version of the game (which includes more extensive design notes and a longer example of play than space permits here). My teaching assistants and I then run three contests simultaneously for the sixteen or so students, using the principles of 'guided competition', outlined in Chapter 7. The games usually take around 90 minutes including my initial brief explanation of the rules, allowing time at the end to discuss what happened in each one and to debate the strengths and limitations

of the model. The 2008 map was just a line drawing on brown card, so the completely redesigned components provided in this book look much better, and build up as illustrated in Figure 9.2 into a full colour map over sixteen inches square, based on the wonderful satellite imagery available free from the NASA website.[45] I will now conclude this chapter by presenting the formal rules of our simulation, both as an illustration of rules drafting and design mechanics and so that you may play the game itself.

ROMA INVICTA?

INTRODUCTION

This is a simulation game of the first two years of Hannibal's Italian campaign (autumn 218 to autumn 216bc) during the Second Punic War. Two players or teams direct the combatants as they strive to protect or undermine the Roman confederacy, or the simulation may be played solitaire to study the dynamics involved.

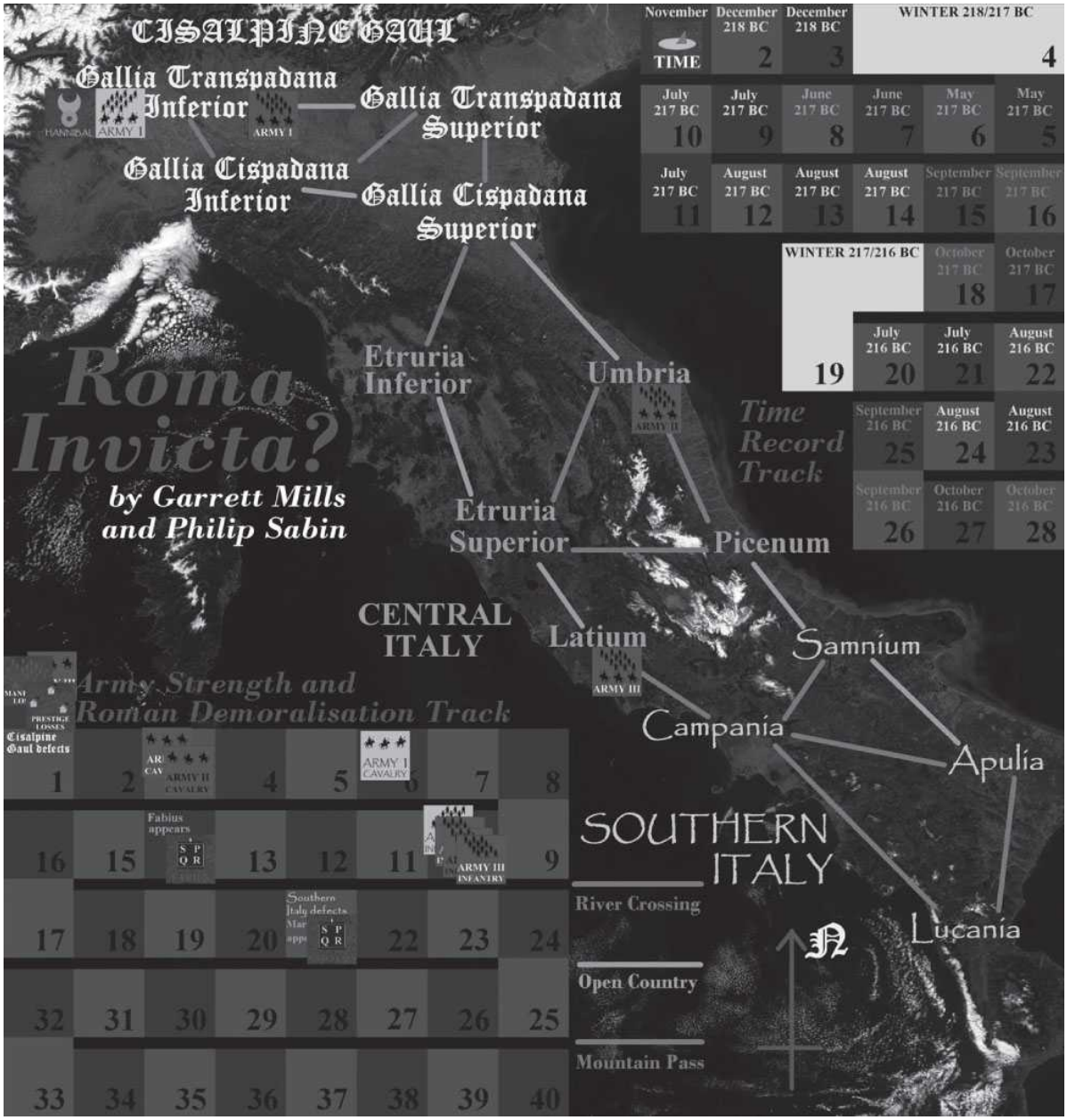
THE MAP

Action takes place on a map of Italy as shown in Figure 9.2, divided into thirteen named regions linked by communication lines that may be open country, river crossings or mountain passes. The regions are grouped into three areas – Cisalpine Gaul, central Italy and southern Italy.

THE PLAYING PIECES

Each side has several army counters (three for the Carthaginians and four for the Romans). These army counters occupy specific regions on the map, or are placed to one side when empty and out of use. Three particularly capable generals (Hannibal, Fabius and Marcellus) are represented by counters, and may be placed with a particular army. Other armies are assumed to be commanded by generic unnamed generals, who provide no game benefits.

Each army has two further counters to record its infantry and cavalry strength on the army strength track, as shown in Figure 9.2. Each strength point represents around 2000 foot or 1000 horsemen. Armies left with no strength points are removed from the map, and are immediately available to be reformed elsewhere. An army may never have more than 40 infantry strength points, and any excess is lost. There are also markers to show the devastation of particular regions, the passage of time and the turn southern Italy defects on the time record track, and Roman losses of prestige and manpower on the Roman demoralisation track.



9.2 *Roma Invicta?* map

SEQUENCE OF PLAY

The game is played in rounds, each of which represents ten to fifteen days of campaigning. In each round, all armies may take *one* action. First, the Punic armies each take one action in any order the Carthaginians desire, and then the Roman armies each take one action in any order the Romans desire. Combat may occur between opposing armies in the same region as a consequence of certain actions. Once all desired actions have been completed, the marker is moved forward on the time record track and a new round begins.

At two points in the game, a winter phase occurs, which represents several months of inaction as the armies shelter in winter quarters. Each winter phase involves Roman redeployment, Punic attrition, and the placement of new levies, as detailed in the Winter and Reinforcement rules below. Play ends as soon as either side achieves a strategic victory as set out in the Victory rules. If neither side does so, tactical victory is assessed by the balance of victory points at the end of the final round of play.

ACTIONS

Each army may take (or attempt) *one* of the following five actions in each round, at the owner's discretion:

MOVE: The army moves into an adjacent region, unless blocked by an enemy army which intercepts the movement.
CONFRONT: The army deploys for battle against an enemy army in its own region.
RAVAGE: The army tries to devastate the territory of its region, unless blocked by an enemy army that offers battle.
REORGANISE: The army either unites with another friendly army in the same region, or splits off some of its own forces as a new friendly army (which may take its own action later that round).
STAND: The army remains in place and awaits events.

MOVEMENT

By using a move action, each army may move to any adjacent region, across any type of communication line (but not if such a line is absent). However, if a Punic army tries to cross a river or mountain pass between two regions that have not both defected, then one Roman army in the starting region may attempt to block the movement if it contains at least a third as many strength points. On a die roll of 5 or 6 (or 3, 4, 5 or 6 if Hannibal commands the moving army), the move proceeds normally. Otherwise, the Punic army's move action is forcibly replaced by a confront action against the blocking Roman army. Only one blocking attempt may be made per moving army or per Roman army in each round, but regardless of the outcome, the Roman army may conduct its own action later that round.

Roman armies may always move freely between regions, because of their control of strategic towns. However, if a Roman army not led by Fabius or Marcellus enters a region other than Latium, one Punic army in the destination region may immediately choose to attempt an ambush as long as the Punic army is led by Hannibal or is in Cisalpine Gaul. On a die roll of 5 or 6, an ambush combat is resolved immediately between the two armies, before any other Roman actions. Only one ambush attempt of this kind may be made per moving army in each round, but a Punic army may make any number of ambush attempts without affecting its own actions. On all rounds after Fabius enters the game (even after he has been removed), such ambush attempts succeed only on a roll of 6.

No Roman army may leave Latium if this would leave fewer than ten Roman infantry strength points in the region. A Roman army may not move from Central Italy to Cisalpine Gaul unless Hannibal is in Cisalpine Gaul or there would still be at least three times as many Roman strength points outside Cisalpine Gaul as inside. There is no need to remedy either of these conditions as long as the movement restriction is observed.

RAVAGING

Each Punic army may attempt a ravage action in any region that is not already devastated or defected. Each Roman army may attempt a ravage action in any region that is defected and not already devastated. Ravaging is not allowed in the first three rounds because of the lateness of the season. The opposing player may automatically block a ravage action using a friendly army with at least a third as many strength points. As when blocking movement, the active army's ravage action is forcibly replaced by a confront action against the blocking army (whose own future actions are unaffected except that it cannot decline battle in this confrontation). If the blocking army is a Punic army in Cisalpine Gaul or led by Hannibal, the Roman army is instead ambushed on a die roll of 6 unless it is led by Fabius or Marcellus.

If a ravage action is not blocked, the ravaging player rolls a die and adds the number of strength points in the ravaging army. The other player rolls another die, multiplies the score by five (or by six if he is Roman and Fabius or Marcellus is in the region), and adds half the number of points in his own largest army in the region (rounding halves up). If the ravaging player's total is greater, the region is devastated, otherwise there is no effect. Devastated regions recover if the region defects or at the end of the next winter phase.

COMBAT

Combat may occur between two armies due to a voluntary or forced confront action by the active army or a Punic ambush of a moving or ravaging Roman force. In voluntary confront actions, the active player chooses which enemy army to confront, while in successful blocking attempts, it is always the enemy player's chosen blocking army that is confronted. If either army during a confrontation in a region other than Latium has at least six times more cavalry strength points than the other (or at least two cavalry points if the enemy has none), it may choose to attempt an ambush. The attempt succeeds on a die roll of 4, 5 or 6 if only the ambushing army has a general, 5 or 6 if neither or both armies have generals, or 6 if only the potential victims have a general. This is separate from any Punic attempt to ambush a ravaging Roman army. An ambushed army has no choice but to accept ambush combat.

If there is no ambush, a confronted army may either accept or decline open battle. Armies with no infantry or which blocked a ravaging attempt must accept battle, but Roman armies that blocked movement may decline battle since they can defend behind the river or in the mountain pass. If battle is accepted, it is a skirmish if either army has no infantry. Otherwise, it may be either a skirmish or a pitched battle – the Roman player decides which on a die roll of 1, 2 or 3, and the Carthaginian player on a die roll of 4, 5 or 6. If a confronted army declines battle, the confronting army may choose either to end its action with no result or to launch an assault on the enemy defensive positions.

Combat consists of one or more 'stages', in which particular subsets of strength points in the opposing armies attack one another. Strength points normally attack in groups of ten, with any remaining strength points attacking as a smaller group. A die is rolled for each group, and if the number of strength points is at least double the die roll, one enemy strength point is destroyed (so a full group of ten strength points would hit on a roll of 1–5 while a single strength point could not hit at all). In an army that is led by Hannibal or is conducting an ambush or defending against an assault, strength points instead attack in groups of five plus

any remainder, and each group hits if the number of strength points at least equals the die roll. Such forces will hence inflict twice as many hits, on average. Note that Hannibal’s army always receives this benefit, even when conducting an assault, but it gets no additional bonus when ambushing or defending against an assault.

No hits are applied until both sides have diced for all their attacks in that stage. The owning player chooses which strength points are lost. Destroyed strength points must come first from the subset engaged in that stage. Any excess losses must be absorbed by the remainder of the army, including strength points already engaged in a previous stage. Hence, some stages in which one side has no eligible strength points may involve unopposed attacks, with all hits carried over to the rest of the enemy force. Once an army is completely destroyed, excess losses are ignored.

COMBAT TYPES

Skirmishes involve a first stage of combat between all the cavalry on both sides (if any). If either side has fewer than four strength points of cavalry, it adds in infantry (if available) to bring it up to four strength points, representing the use of light infantry skirmishers. If one force suffers more hits than it inflicts, and is not led by a general, it is routed, and surviving enemy cavalry (*not* light infantry) roll again to inflict hits in a second stage on the fleeing survivors of the engaged force. Any excess hits in either stage are carried over to the rest of the army.

Assaults involve a single stage of combat between all the infantry strength points on both sides (with the defenders fighting at enhanced effect). Cavalry play no role on either side, although they must absorb any excess losses.

Ambushes involve a first stage of combat between all the strength points on both sides (with the ambushers fighting at enhanced effect). Then, if the ambushed army lost more strength points, it suffers additional losses equal to the number of remaining strength points in the ambushing army, and so may well be completely annihilated.

Pitched battles proceed in three stages. First, each side's cavalry (if any) attack one another (with no light infantry participation as in skirmishes). Any excess losses are carried over to the infantry. Next, the remaining infantry on both sides fight one another, with any excess losses carried back to the cavalry. Finally, the losing side (if any) may suffer pursuit. An army loses the battle if it lost all its infantry or if it lost more strength points overall and also lost at least as many infantry points as the enemy (including through excess losses from the cavalry combat). If the losing army inflicted at least as many hits as it suffered in the first stage cavalry combat, it loses just one extra strength point of the owner's choice in the pursuit, and even this is negated if it has a general. However, if the losing army inflicted fewer hits than it suffered in the first stage cavalry combat, the pursuit stage is much more devastating. First, the fleeing army loses as many infantry points as there are surviving enemy cavalry points, with any excess hits carried over to the fleeing cavalry unless the

losing army has a general. Then, if Hannibal has beaten a Roman army that is not in Latium or led by Fabius or Marcellus, a die is rolled, and on a score of 4, 5 or 6, the Romans are encircled (as at Cannae) and lose as many additional infantry points as there are surviving Punic infantry points, with any excess hits not in this case carrying over to the fleeing cavalry.

REORGANISATION

An army may use a reorganise action to split off any desired subset of its strength points into a new army if one is available. The original army has undertaken its action, but the new army may take an action of its own later that round. Alternatively, an army may use a reorganise action to disband and merge with another friendly army in the region. That army may either already have taken an action this round, or may do so after absorbing the troops from the disbanded army. Generals may transfer freely between armies involved in a reorganise action, but are lost if their army is removed in any other circumstance.

DEMORALISATION

Rome has two markers on the Roman demoralisation track, to record its losses in manpower and prestige as the campaign proceeds. The more advanced of the two markers represents the demoralisation level of the Roman confederacy. Both markers start in the zero space, and they may never be moved back beyond this space.

Once all stages of a combat (including pursuit) have been completed, the manpower loss marker is advanced a number of spaces equal to half the Roman strength points lost minus the full number of Punic strength points lost in the combat. If the result is negative, the marker is moved back. Halves are rounded up on a die roll of 4, 5 or 6, and down on a die roll of 1, 2 or 3. Losses outside combat never affect the marker. The prestige loss marker is moved as shown on the following list. Where two adjustments are shown, the one before the slash applies if the manpower loss marker is currently ahead of the prestige loss marker, while the adjustment after the slash applies if the prestige loss marker is currently in the same space as or ahead of the manpower loss marker:

+6/+9 if the Carthaginians devastate Campania.
+3/+6 if the Carthaginians devastate a region other than Campania.
+2/+5 if Hannibal starts a winter phase with fewer than five points of Romans in his region.
+2/+5 if Hannibal with at least ten infantry points performs a stand action in a defected Campania not containing a Roman army with at least five infantry points.
+1/+4 when a confronted Roman army declines battle.
+1/+4 when a Roman army leaves a region containing at least five Punic strength points, unless the region is defected and devastated or the region entered also contains a Punic army.
−2 when a Punic army attempts to leave Latium.
−2 if the Romans devastate a region other than Campania.
−5 if the Romans devastate Campania.

DEFECTION

Cisalpine Gaul defects at the end of any round when Hannibal is in the area and the Roman demoralisation level is one or more. Southern Italy defects at the end of any round when Hannibal is in the area and the Roman demoralisation level is 21 or more. Defection never takes place during a winter phase. When defection occurs, all devastation markers are removed from regions in that area, and Hannibal's army receives reinforcements. Defected areas remain so for the rest of the game, even if the demoralisation level falls. Once an area has defected, no Punic army may move out of the area into central Italy if this would leave fewer than ten Punic infantry strength points and two Punic cavalry strength points in the area concerned. There is no need to remedy this condition as long as the movement restriction is observed.

WINTER

Play is punctuated by two winter phases. After any prestige adjustment for Hannibal being unopposed, each Roman army may (but need not) be redeployed to Campania or to any region of central Italy. Redeployment ignores distance and enemy armies, and involves no prestige costs, but no army may be redeployed from Latium if this would leave fewer than ten Roman infantry strength points in Latium. If Fabius is on the board, he is removed from play as his six-month term as dictator expires.

Next, each Punic army in central Italy or in a devastated region suffers winter attrition. It loses one-third of its cavalry strength points and one-fifth of its infantry strength points, rounding fractional losses down for each. Reinforcements are now assigned to existing or newly created armies, with the Carthaginian player doing so first. Finally, all devastation markers are removed, and the time marker is advanced to the next round of campaigning.

REINFORCEMENTS

When Cisalpine Gaul defects, Hannibal's army gains five infantry and five cavalry points. When southern Italy defects, Hannibal's army gains five infantry points. In the first winter phase after an area defects, a new Punic army is placed in any region of the area. This has ten infantry and two cavalry points in Cisalpine Gaul, or five infantry and one cavalry points in southern Italy. Alternatively, these points may be added to any one existing Punic army in the area. Each winter phase, five infantry strength points may be added to any one Punic army, or shared among more than one.

Rome receives 20 infantry and four cavalry points in the first winter phase, and 30 infantry and six cavalry points in the second winter phase. These reinforcements may be added to one or more existing armies in Campania or central Italy, or some or all of them may be used to create one or more new armies in Campania or central Italy. No infantry strength points may be assigned elsewhere until Latium has at least ten infantry points.

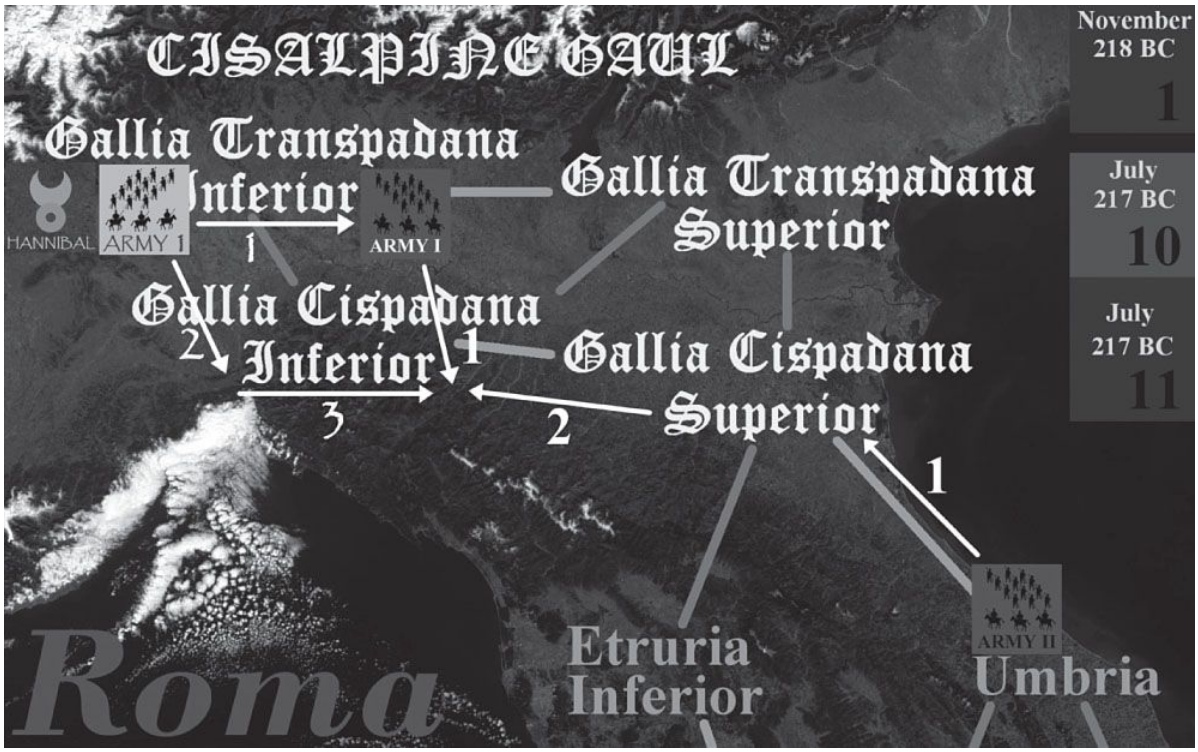
Rome also receives emergency reinforcements when its military losses reach certain levels. If the military loss marker stands at fourteen or more at the end of any round, ten infantry and two cavalry strength points and the general Fabius are added to a Roman army in Latium. If the military loss marker stands at 21 or more at the end of any later round or winter phase, ten infantry and two cavalry strength points and the general Marcellus are added to a Roman army in Latium. At the end of any round when there are fewer than two Roman cavalry points on the map (including emergency reinforcements), two cavalry points are added to a Roman army in Latium.

VICTORY

The Romans win a strategic victory if Hannibal is lost or if southern Italy remains undefected at the end of the game, while the Carthaginians win a strategic victory if there are ever at least three times as many Punic as Roman infantry strength points in Latium, or if the Roman demoralisation level ever exceeds 40. Otherwise, the Romans get as many victory points as the number of the round on which southern Italy defects (as recorded by the marker provided), while the Carthaginians get as many victory points as the average of the Roman manpower and prestige loss levels at the end of the game. The side with more points wins a tactical victory, with the difference between the scores reflecting the margin of success, but the war itself remains undecided and will drag on for many years to come.

INITIAL SETUP

As shown in Figure 9.2, the first Punic army begins in Gallia Transpadana Inferior, with Hannibal, ten infantry and six cavalry strength points. The first Roman army (historically led by the consul Scipio the Elder) begins in the same region with ten infantry and three cavalry strength points. The second Roman army with ten infantry and three cavalry strength points (historically commanded by the consul Sempronius) begins in Umbria. The third Roman army with ten infantry strength points and no cavalry strength points (the legiones urbanae) begins in Latium. The time marker begins in round one of the time record track, and the manpower and prestige loss markers start in the zero space of the Roman demoralisation track. All other armies, generals and markers are placed aside for now.



9.3 *Roma Invicta?* example

EXAMPLE OF PLAY

Round one begins with Punic actions. Hannibal's key initial priority is to inflict the very small Roman setback, which is all that is needed to prompt the restive Gauls to rise up and join him, so he confronts Scipio the elder's nearby army. Since the Roman prestige and manpower loss levels are both equal on zero, declining battle would cost the Romans four prestige points, so they accept, despite their inferiority in cavalry and generalship. On a die roll of 2, the Romans get to choose the type of combat, and they opt for a skirmish so as to minimise their losses. This sets the stage for the historical initial clash at the river Ticinus.

All six Punic and three Roman cavalry points will be engaged, and the Romans add in a further point of light infantry to bring them up to the minimum of four points. Thanks to Hannibal's bonus, the Carthaginians fight in one group of five points and a second group with a single point, and with die rolls of 5 and 2 respectively, they inflict one hit. The Romans fight in one normal group of four points, and since their die roll of 3 is more than half their points total, they fail to hit. The light infantry are lost to satisfy the Punic hit, but because the Romans suffered more hits than they inflicted and do not have a capable general, the Carthaginian horsemen get to pursue. This time they get lucky and roll 4 and 1, so inflicting two more hits and destroying two Roman cavalry points. On a die roll of 3, the three Roman losses are rounded down when halved, so the manpower loss counter is advanced one space on the Roman demoralisation track.

Scipio, with nine infantry and one cavalry points remaining, is now outnumbered 6:1 in horsemen, so there is a 50:50 chance of being ambushed if he gets into another confrontation with Hannibal. Hence, he takes advantage of the prestige loss level now being below the manpower loss level, and withdraws across the Po to Gallia Cispadana Inferior at the cost of one prestige point. Sempronius, with the other Roman army, hastens from Umbria to Gallia Cispadana Superior to reinforce his consular colleague and to avoid Hannibal being unopposed when campaigning ends for the year. (The usual restriction on moving more than a quarter of the Roman army into Cisalpine Gaul does

not apply while Hannibal is still there.) The third Roman army in Latium needs to remain in place to garrison Rome. Since Roman manpower and prestige losses have now both reached the crucial threshold of one point (just one of them would have been enough), Cisalpine Gaul defects at the end of the round, and Hannibal's army gains reinforcements which bring it up to fifteen infantry and eleven cavalry strength points.

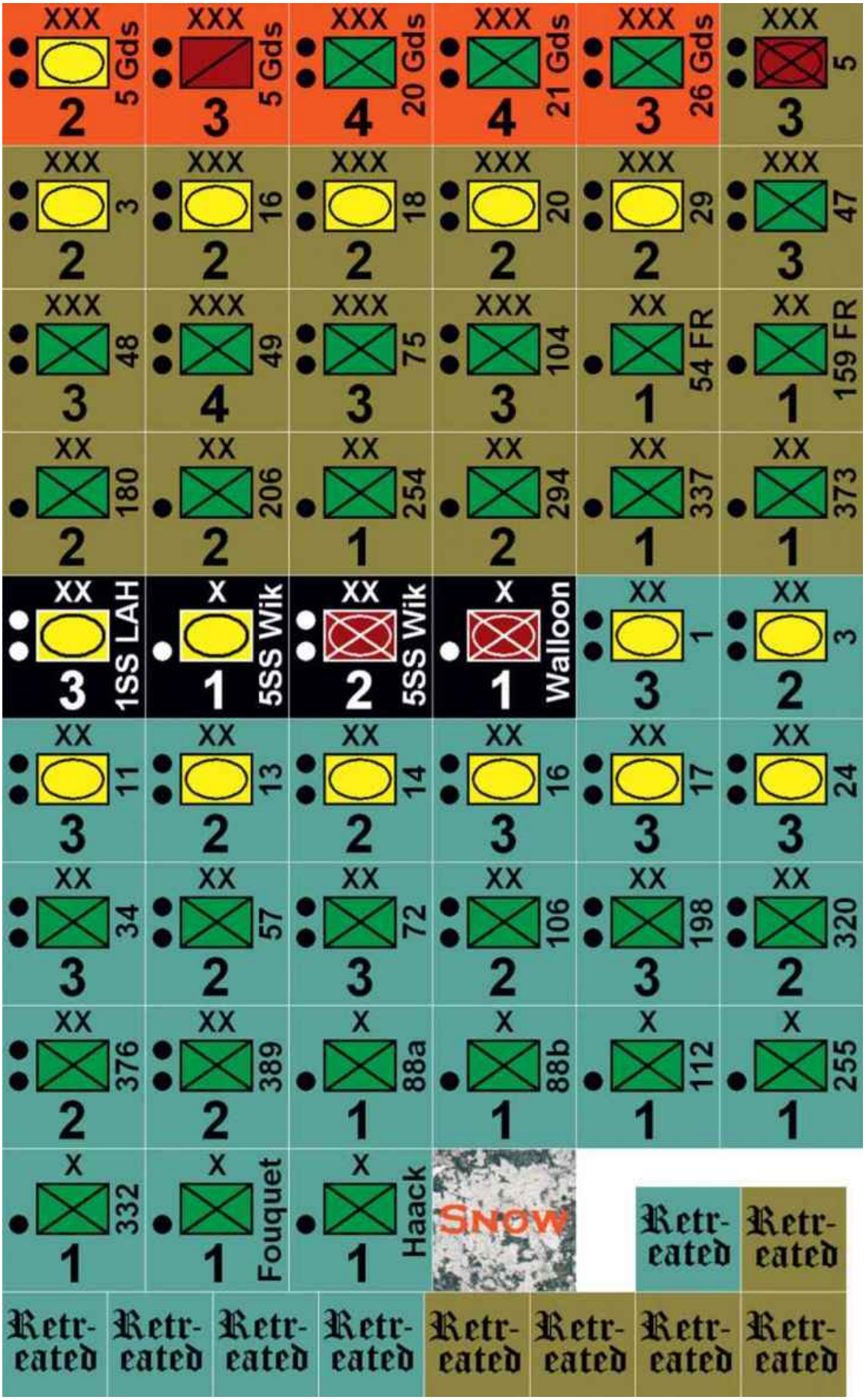
Round two sees Hannibal cross the Po in pursuit of Scipio. There is no chance of the Romans blocking this crossing, since the blocking army needs to be in the starting region rather than the destination region. Since Cisalpine Gaul has now defected, Sempronius's army would usually be able to conduct a ravage action in the hope of regaining some Roman prestige and thereby allowing Scipio to withdraw further without too much loss of face, but this is prohibited for now because of the lateness of the season. Hence, Sempronius instead marches on into Gallia Cispadana Inferior to join his colleague. Before he can do so, the Carthaginians get a one in three chance to ambush Sempronius's moving army, both because Hannibal is present and because the Romans are entering a region in Cisalpine Gaul. The ambush attempt fails on a roll of 4, and Scipio finishes the round with a reorganise action which he uses to merge the two Roman armies into a combined force with nineteen infantry and four cavalry points.

On round three, Hannibal could freely move on through the open country into Gallia Cispadana Superior to prepare for his southward attack in the new year, but he decides instead to confront the Roman army and so gain either a four-point prestige dividend if they refuse battle, or another chance of a decisive victory. The Romans once again accept the challenge, and this time it is the Carthaginians who get to decide the form of combat, on a roll of 5. They opt for a pitched battle, setting the stage for the historical contest at the River Trebia.

The cavalry combat is very one sided, with three Punic groups of five, five and one strength points facing just one normal Roman group of four strength points. Hannibal's die rolls of 2, 5 and 4 yield two Carthaginian hits, while the Romans again fail to hit with a die roll of 3. In the infantry combat, three Punic groups each of

five points face two normal Roman groups with ten and nine points. The Carthaginians hit three times with rolls of 4, 5 and 2, while the Romans hit twice with rolls of 1 and 4. Since the Romans have lost five points overall to the Punic two, and have not inflicted more infantry hits than they received, they lose the battle, and since they also suffered more hits in the cavalry combat, they are vulnerable to a full pursuit. Eleven more Roman infantry points are destroyed by the eleven Punic cavalry points, but on a die roll of 3, the Romans narrowly escape complete encirclement, leaving them with just five infantry and two cavalry points. The net loss of sixteen Roman and two Punic strength points means that the manpower loss level is advanced from one to seven. As their last act of the year, the consuls use a stand action to seek temporary refuge in Placentia.

In the winter phase, the surviving Romans are just strong enough to deny Hannibal the two prestige points for being unopposed. The depleted Roman army is now redeployed to Umbria to help guard central Italy from the imminent invasion. Thanks to its local support, Hannibal's army does not suffer from winter attrition, and it absorbs the five points of new levies to bring it up to eighteen infantry and eleven cavalry strength points. Meanwhile, a new Carthaginian army of ten infantry and two cavalry points is raised from the defecting Gauls in Gallia Cispadana Superior, ready to provide the minimum garrison as Hannibal moves south. Roman reinforcements are used to boost the army in Umbria to thirteen infantry and four cavalry points under the new consul Servilius, while a fresh army under his colleague Flaminius takes the remaining twelve infantry and two cavalry points and is deployed in Etruria Inferior to guard the invasion routes across the Apennines. Whichever route Hannibal takes, the Romans are now set to inhibit his ravaging with one consular army, while declining battle until the other consul arrives with reinforcements. The main problem is the ever present risk of an ambush, as happened historically as Flaminius pursued Hannibal into Etruria Superior along the shores of Lake Trasimene.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XX 159 FR 1
XX 180 2
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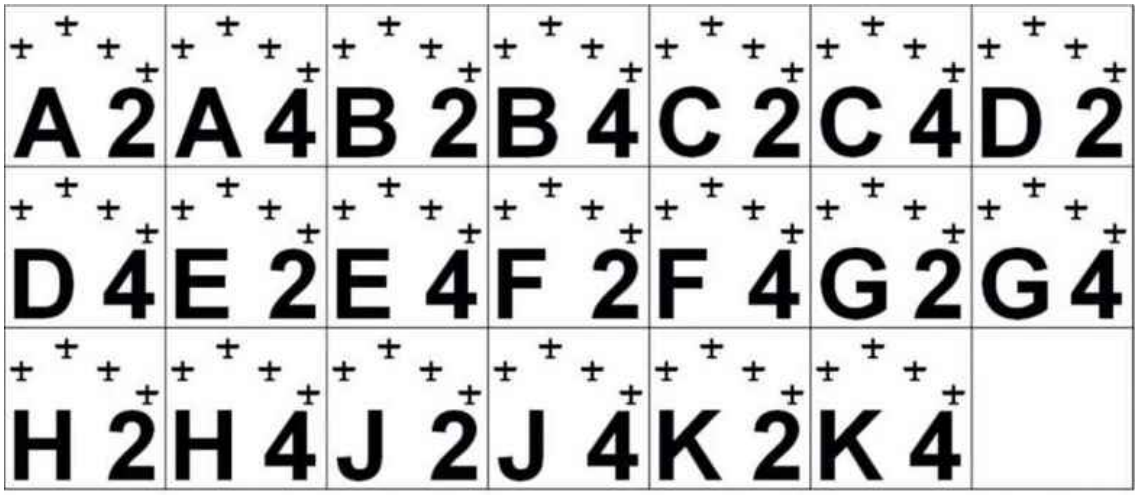
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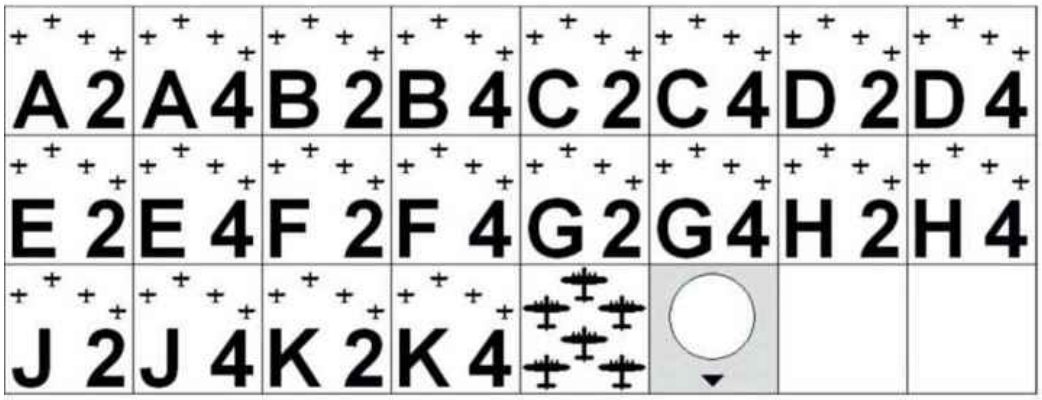
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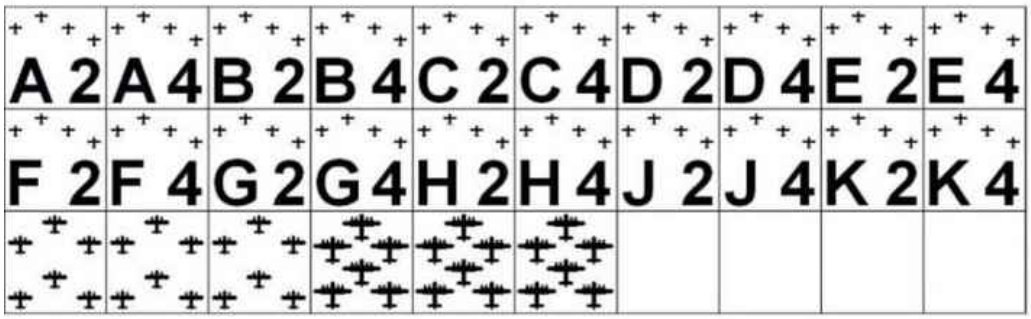
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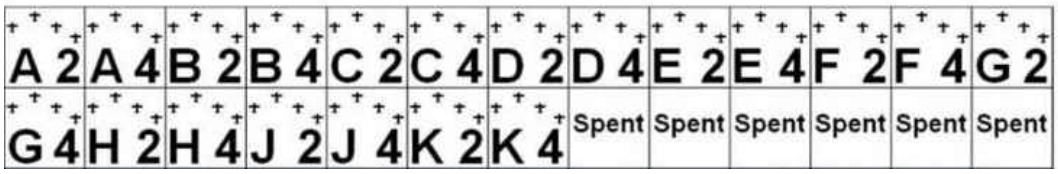
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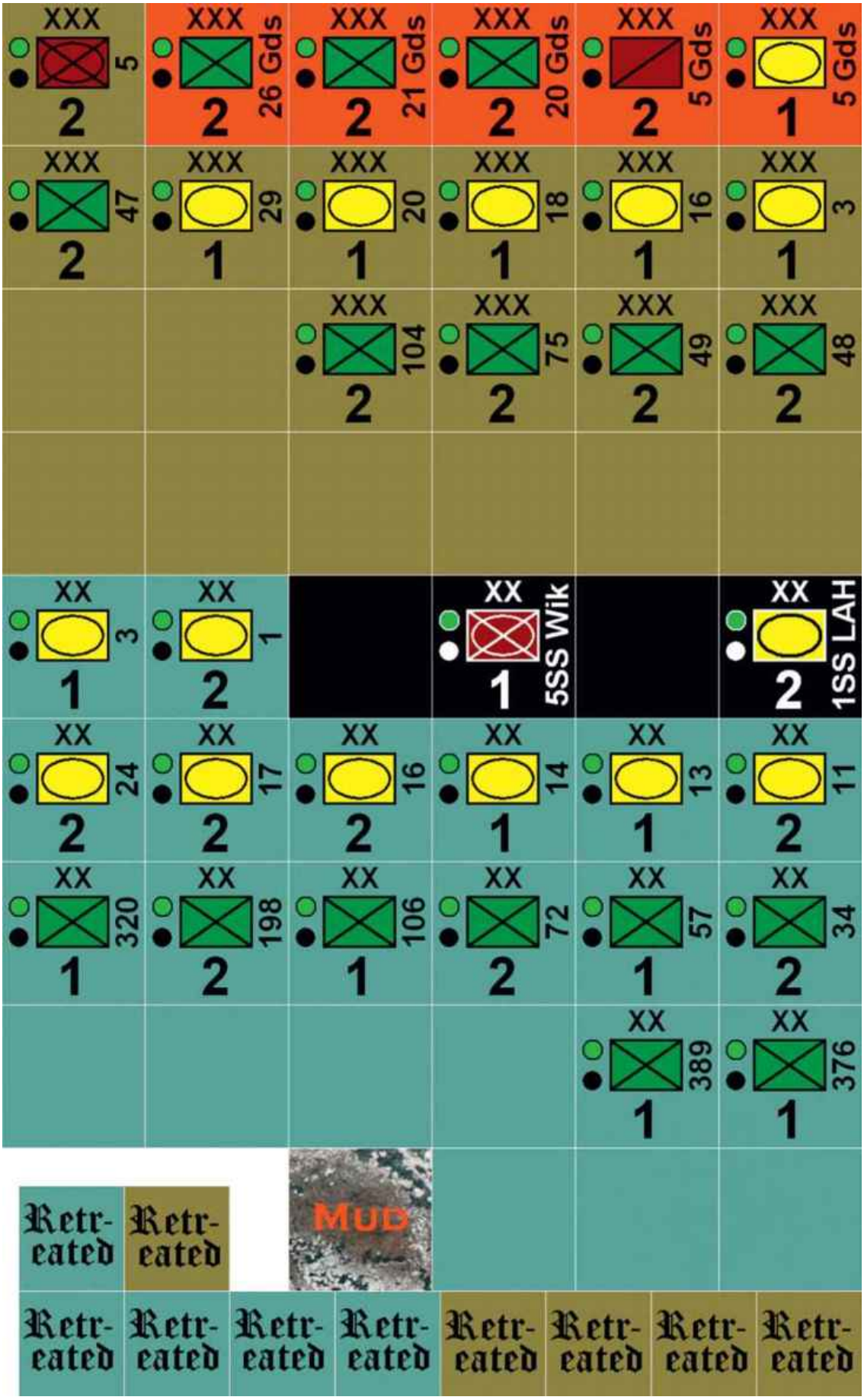
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H 5	H 3	G 5	G 3	F 5	F 3	E 5	E 3
				K 5	K 3	J 5	J 3

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K 5	K 3	J 5	J 3	H 5	H 3	G 5	G 3	F 5	F 3

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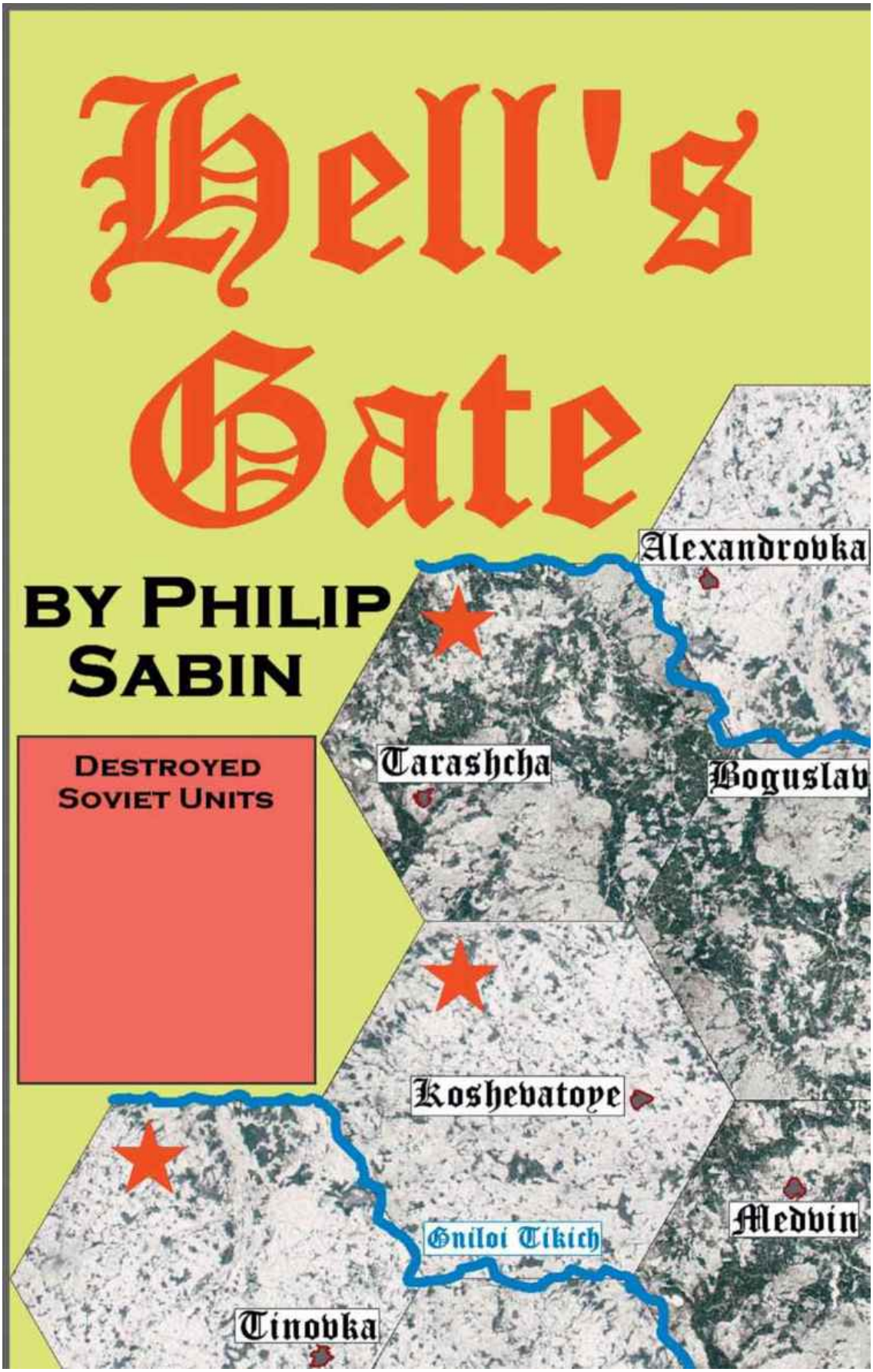
Hell's Gate

BY PHILIP SABIN



December 218 BC 2
December 218 BC 3
WINTER 218/217 BC 4
July 217 BC 9
June 217 BC 8
June 217 BC 7
May 217 BC 6
May 217 BC 5
August 217 BC 12
August 217 BC 13
August 217 BC 14
September 217 BC 15
September 217 BC 16
WINTER 217/216 BC 19
October 217 BC 18
October 217 BC 17
July 216 BC 20
July 216 BC 21
August 216 BC 22
Time Record Track
September 216 BC 25
August 216 BC 24
August 216 BC 23
September 216 BC 26
October 216 BC 27
October 216 BC 28
Picenum

THE KORSUN POCKET 1944
Bukrin
DNEPR
Maslovka
Kanev
Rossava
Yanovka
Ross
Korsun
Shenderovka
Gorodische

GAUL
November
218 BC
1
Gallia Transpadana
Superior
July
217 BC
10
Gallia Cispadana
Superior
July
217 BC
11
Etruria
Inferior
Umbria
Etruria
Superior

10

World War Two

Time has eroded our empathy with the human suffering that the struggles of antiquity involved, even though this suffering was no less acute than in more recent conflicts – the fatalities suffered in a single day at Cannae and also in the great Roman naval disaster off Camarina 40 years earlier dwarfed those inflicted on the notorious first day of the Somme, and conquerors such as Genghis Khan and Tamerlane were every bit as genocidal as the Nazis and other totalitarian regimes.[1] However, in the much better documented conflicts fought within living memory, the human cost of war looms much larger in our minds. I discussed in the Introduction and in Chapter 1 the very considerable stigma that the notion of 'wargaming' evokes among the uninitiated, and a large part of this stigma surely derives from the perceived inappropriateness of reducing the tragic destructiveness of armed conflict to some kind of amusing parlour game. Hence, before I discuss my use of wargaming techniques to cast light on the particularly brutal struggles that took place between 1939 and 1945, it is appropriate to consider for a moment the ethics and morality of this form of conflict simulation.

Wargamers rarely reflect explicitly on the morality of their activities, except to point out that their simulacra do not themselves cause suffering, and are more likely to dampen than to inflame real combative urges.[2] H.G. Wells expressed this eloquently in his pioneering text on figure gaming almost a century ago:

> How much better is this amiable miniature than the Real Thing? Here is a homeopathic remedy for the imaginative strategist. Here is the premeditation, the thrill, the strain of accumulating victory or disaster – and no smashed nor

> sanguinary bodies, no shattered fine buildings nor devastated country sides, no petty cruelties, none of that awful universal boredom and embitterment, that tiresome delay or stoppage or embarrassment of every gracious, bold, sweet, and charming thing, that we who are old enough to remember a real modern war know to be the reality of belligerence.[3]

The outbreak of World War One just a year after the publication of Wells' book gives an added piquancy to his sentiments. Perla expressed a similar view 20 years ago in his own definitive study of wargames theory, when he wrote that; 'In today's world, where another Great War could well mean the end of mankind, wargaming is not just a hobby for the over-educated or a toy for the military-industrial complex, it is a way to help us understand the nature of the beast, and through that understanding to, if not tame it completely, at least prevent it from devouring us.'[4]

Two kinds of board wargame (as opposed to violent video games) have sparked minor ethical controversies. The first type includes games about very recent, ongoing, or potential future conflicts. Professional wargamers study such conflicts as a matter of course, but some hobbyists such as Charles Vasey feel uncomfortable modelling wars in which the image of casualties is still very fresh, and during the Cold War there were sporadic protests about hobby games that simulated possible armed hostilities between east and west (especially where this involved the hypothetical use of nuclear weapons).[5] In 2010, British defence minister Liam Fox expressed disgust at a commercial video game that allowed players to act as the Taliban as well as the British forces, presumably unaware that his own ministry had distributed a similar game as a recruitment device the previous year.[6] The second type of board wargame that has occasionally proved controversial is one in which the historical conflict incorporated deeply unsavoury elements that critics argue the games elide. In a 2008 book, Smelser and Davies included wargames as one of several means by which Germany's military conduct of World War Two in the east had become 'romanticised', thereby occluding the unspeakable crimes of the Nazi regime.[7]

Even a game on the much more remote topic of King Philip's War in New England in 1675–6 triggered a minor furore when Native American groups protested on similar grounds.[8] Tim Cornell argued that such considerations applied to games on all eras of military history. In his words:

> The trouble precisely with war games which take you back into periods about which we know nothing, or very little, and cannot understand, is that you do it in a moral vacuum. I don't think wargaming is wicked in itself, or that war is necessarily bad at all. Indeed, I think there is a very strong moral dimension, and you've got to have good reason to engage in war, and this should be reflected at the level of games too.[9]

Just as academic game theory reduces strategic choices to the optimisation of abstract mathematical 'payoffs', so wargames by their very nature give little if any sense of the human consequences of the actions they model. Military units that suffer losses simply have their counters flipped over or removed from play, and the civilian population of the war zone is not usually modelled at all. Simulations of modern conflicts do bring in more of the political and media dimension alongside narrow military considerations, and one of my MA students even presented players of his game on the 1957 Battle of Algiers with the historical dilemma of whether to use torture to gain intelligence (a dilemma that has gained renewed force in the context of the current 'War on Terror').[10] However, in the end, such calculations still come down to cost–benefit choices framed by the designer in terms of an abstract currency of victory points, and they give little feel for the moral burdens borne by the real combatants.

Whether this constitutes a fatal objection to either wargaming or game theory is another question. Even the most detailed simulation or book cannot hope to portray more than a fraction of the issues bearing on real conflicts involving many millions of individuals, as the stark contrast between the 'definitive' books on Stalingrad by Beevor and Glantz makes very clear.[11] Board wargames are abstract reflections of a few of the physical

dynamics of particular armed conflicts, and their devotees tend to be peaceable, intelligent and often rather apolitical individuals who read widely about all aspects of military affairs.[12] There is no sense, as some have argued with violent video games, that playing the simulations fosters real-life aggression and desensitises users to the moral gravity of actual warfare and killing.[13] Indeed, the experience of seeing how easily plans can go awry and severe losses can be sustained is far more sobering and salutary than the jingoistic feelings of invincibility fostered by *Rambo*-style movies and video games.[14] Being forced to play and study both sides in a conflict rather than just leading the 'good guys' makes manual wargamers less likely to caricature opposing forces. Although there are plenty of simulations that could be accused of amoral fascination with German military prowess, this is nothing compared to the number of books focused on 'elite' formations such as the SS, and wargame designers such as the left-leaning Jack Radey were actually ahead of the curve during the Cold War in challenging the dominance of German memoirs in western historiography and giving proper credit to the Red Army for its achievements in overcoming the Nazi threat.[15] As I discussed in Chapter 1, conflict simulations are no different from books and films in that they provide users with an interesting and instructive vicarious portrayal of the dynamics of armed conflict, while preserving those users from the traumatic personal experience of killing and being killed. They may be less familiar to the wider public than films or books, but they are no more intrinsically immoral than are the many other ways in which the dreadful but compelling and fascinating reality of warfare is represented for our interest and enlightenment.

In my second-year BA course on the strategic and operational dynamics of World War Two in Europe, I have long used two simple simulations to bring home to students the grand strategic dynamics of this terrible conflict. One covers the entire *Second World War* in Europe, the Mediterranean and the Atlantic from the summer of 1940, while the other focuses on the land battle on the *Eastern Front* from 1941 to 1945. Each forms the basis of a two-hour class, and my teaching assistants and I run three contests simultaneously for the 30 or so students. The two exercises

occupy quite a lot of class time, but they are more involving and educationally worthwhile than simply lecturing students on material they can easily pick up outside class from one of the many excellent modern books on the conflicts concerned.[16] *Second World War* uses twelve irregular regions in four strings radiating out from Germany in the centre, and is played in ten half-yearly turns. *Eastern Front* uses 21 large hexes each representing an area around 250 miles across, and it is broken down into sixteen seasonal turns (although most of our groups only have time to refight the first two or the last two years of the campaign). Both simulations use around 40 units, of two main types – combat units (representing land and tactical air forces) and production units (representing factories, manpower concentrations, mines and oilfields). *Second World War* also has a few strategic units (representing the offensive and defensive forces engaged in the Battle of the Atlantic and the bombing of Germany). To keep things simple, there are no distinctions within these two or three unit types except the side to which the units belong.

The basic mechanism in both games is that each side takes it in turn to launch attacks with its combat units into chosen enemy regions. The attacking unit automatically becomes spent, and a die is rolled to see if a defending combat unit also becomes spent, with the chance of success depending on factors such as terrain and weather. Once all defenders in a region have become spent, a further hit forces them all to retreat and allows the attackers to occupy the region and overrun any production units there. Each side finishes its turn by mobilising new units or making as many spent units fresh as it has intact production units. The system thus shows clearly how success in this drawn-out attritional contest depended both on the immediate force balance at the fighting front and on the ability to replace losses so as to sustain the struggle in the longer term. In both games, the Axis powers start out with superior forces (representing qualitative rather than quantitative superiority), and the onus is on them to win quick *Blitzkrieg* victories and so cripple Allied combat potential before growing Allied resources and combat effectiveness halt and roll back the Axis tide. There is a slim chance of the Axis winning outright by conquering Britain or the USSR, but most contests are

decided instead by whether Berlin falls sooner or later than it did historically. One major abstraction is that Axis production potential remains fairly constant throughout both games, whereas in reality it started out at a low level and then expanded many fold by 1944 thanks to Speer's economic mobilisation.[17] Had I reflected this growth more directly, I would also have had to include all sorts of special rules allowing the Germans to achieve cheap and one-sided offensive victories in the early years of the war thanks to their initial advantages in doctrine and leadership, so I decided instead to keep things simple and let the two offsetting factors cancel out.

The *Second World War* simulation presents both sides with challenging and instructive dilemmas regarding the best allocation of scarce resources to the different fronts. The Germans must choose how far to persist in attacking Britain before turning against the USSR, while the western Allies must decide whether to emphasise land, sea or air capabilities, how many resources to send to aid the Soviet war effort, and whether to invade Sicily and Italy in 1943 or to launch an early cross-Channel attack.[18] The *Eastern Front* game highlights other dynamics, in particular the importance of force to space ratios and the way in which the terrain and the force densities on the northern half of the front led to a prolonged stalemate outside Leningrad and Moscow while both sides concentrated their efforts in 1942–43 on the more open and sparsely manned sectors in the south. The simulation encourages the historical alternation of Axis summer and Soviet winter offensives, and it clearly shows that the famous battles at Moscow, Stalingrad and Kursk made up only a small proportion of the overall attritional struggle.[19] Both simulations are available for free download from my conflict simulation website. They include extensive examples and design notes, and provide graphics files allowing them to be played in hard copy or on the PC screen.[20] I urge you to download and study them as illustrations of how even massive and complex modern conflicts may be captured within accessible models using the principles of abstraction and simplicity that I outline throughout this book.

In line with my approach of using 'nested sets' of simulations as explained in Chapter 9, I will spend the rest of this chapter

detailing two operational-level games that model in more detail certain specific aspects of the overall conflicts covered in the grand strategic games. Both of them are set at the start of 1944, but otherwise they are very different in terms of ground and timescales. The first simulation covers an area stretching all the way from England to southern Italy, but instead of representing an entire season of fighting as in *Eastern Front*, each turn contains just 30 minutes of action, since the game models a single day of US strategic bombing raids during the *Big Week* offensive. The second simulation has much more evenly matched ground and time scales, with each hex representing an area some 20 kilometres across and each turn representing three days of fighting. The game covers the battle of the Korsun pocket in Ukraine, when several German divisions were encircled as at Stalingrad in a pocket they described as *Hell's Gate*, but managed to effect a messy breakout to join the relieving panzer forces.

I use the *Big Week* simulation not in my course on World War Two but in my smaller third year BA course on fighting in the air. We tackle the dynamics of daylight air combat in 1939–45 over no less than six weeks of classes, as we gradually expand upwards from the ultra-tactical perspective of individual aircraft cockpits to a strategic overview of entire air campaigns such as the Battle of Britain and the bombing of Germany. The *Big Week* game comes in the fifth of the six weeks, and its main educational objective is to bring home to the students the crucial importance of fighter range and endurance (for the defending as well as the attacking aircraft), given the massive distances and areas which the air offensive against Hitler's Reich encompassed compared to the relatively compact nature of the air battle over southern England in 1940. I have analysed these air campaigns in my own more conventional academic studies, and a key concept I have employed is that of 'force gradients' whereby the effectiveness of a given force decreases steadily the further away it has to operate from its air bases.[21] Other operational or strategic wargames often simplify this gradual diminution of effectiveness by ruling that air units have a constant combat power up to a certain radius of action from their base and are entirely prohibited from operating any further away, but I wanted my students to develop a more

subtle understanding of the force–space–time dynamics underlying air operations in this period.[22] They will hence understand why drop tanks were used routinely even by the German interceptors, to allow them to redeploy against distant bomber raids while retaining sufficient fuel for the ensuing engagement.[23]

For several years, I actually used the map and some of the counters and rules from a more detailed published wargame to illustrate these points, namely Craig Taylor's 1982 simulation *Bomber* (which I illustrated in Figure 5.1).[24] This simulation captures very well the impact of fuel requirements on aircraft range, speed, endurance and payload, and it is handicapped only by the hex grain distortions mentioned in Chapter 5. However, I was constantly having to simplify the game system and reduce the number of counters to allow even a single day of raids to be completed in a two- hour class, and this process eventually reached the point at which I decided to construct my own dedicated simulation instead.[25] It is actually very common for freestanding game designs to start off as tweaks and modifications to someone else's published system (or to an earlier design of one's own), and several of my own simulations including my *Lost Battles* system and the *Hell's Gate* game later in this chapter have evolved gradually in this way.[26] This bears out what I said in Chapter 2 about critical playing of existing board wargames burgeoning seamlessly into design endeavours, and it shows the value of studying the established wargames corpus, even though most published simulations are far too complex and time consuming to be used directly in class. (The 1999 computer game *Twelve O-Clock High* models each raid down to the level of individual aircraft, but the rules of this detailed bottom up simulation extend to over 100 pages, and the inability of users to adapt and tailor the programmed system as they can with manual games is a major hindrance to educational employment, just as I discussed in Chapter 2.)[27]

There is a mass of literature concerning the US daylight strategic bombing campaign, as well as numerous technical and organisational studies of the equipment and air forces involved on both sides.[28] Unfortunately, I have not found any detailed forensic

reconstruction of the Big Week raids comparable to Middlebrook's book-length analysis of the Schweinfurt–Regensburg mission in August 1943 or Ethell and Price's similar study of the US raid on Berlin on 6 March 1944.[29] The latter raid occurred only ten days after Big Week, and it might have been easier to simulate this Berlin attack instead, but I wanted to include raids not just by the Eighth Air Force from England but also by the Fifteenth Air Force from southern Italy, so as to illustrate to the students how much of a strategic difference the acquisition of airfields around Foggia made to the Allied bomber offensive by exposing a whole arc of targets from southern Germany to Rumania. Hence, I decided to use Ethell and Price's book only as a comparative source, and to focus my own simulation on 25 February 1944, a clear day when around 1000 heavy bombers escorted by a similar number of fighters attacked the aircraft factories of south eastern Germany from two completely different directions on the last day of the Big Week campaign.[30]

A key factor that I wanted the game to illustrate was the US shift in December 1943 from close escort to phased escort tactics, within which the bombers would be guarded by successive relays of fighters rendezvousing at different points of their outward and return flight. This reduced the number of fighters escorting the bombers at any one time, but it allowed the fighters to use a weaving flight path to keep their speed up for air combat during their briefer periods of guard duty, and it enabled the outward and return legs of the flight to be escorted by successive waves of P-47 Thunderbolts while the longer range P-38 Lightnings and P-51 Mustangs focused on supporting the bombers in the more distant airspace around the target itself.[31] Taylor's game *Bomber* illustrates this very neatly and realistically by having the bombers cruise at two hexes per turn while fighters cruise at three hexes per turn, so that fighters that stick with the bombers have their effective range reduced by one-third during the limited number of turns they can remain aloft.[32] I decided to use exactly the same system and just to employ slightly larger hexes. Since bombers cruised at around 180 mph, I opted to use half-hour turns and hexes each representing an area 45 miles across.[33] Fighters hence cruise at around 270 mph (45 3 3 3 2), and I also

incorporated Taylor's idea of letting them push the throttle and travel at 360 mph instead, at the cost of using fuel at twice the normal rate.

Covering an area from England to southern Italy at this 45 mile per hex scale needs a lot of small hexes on the eight by sixteen inch map provided in the colour plates, so I decided to leave the US base areas off the hex grid and to represent them instead by boxes, hence giving more space to display the status of the many US counters. A section from NASA's 'Blue Marble' image of the Earth provides a wonderful backdrop for the map and I made sure that the hex grain runs eleven hexes straight from the two US base areas to the primary target of Regensburg, so as to minimise the distortions highlighted in Figure 5.1.[34] Taylor's game uses one counter for each historical group or *Gruppe*, containing between ten and 60 aircraft each. However, experience has taught me that this makes the contest far too long for a two hour class, so I now use counters representing around 100 aircraft each instead, so as to leave time for the students to study the withdrawal phase and to have some units on both sides fly a second sortie as happened historically.[35] This requires significant abstractions regarding aircraft types and basing, and I have chosen to base German units mainly at the headquarters of the various fighter divisions rather than trying to distinguish the many individual airfields in use.[36] I also know from experience that having attributes such as unit strength and remaining endurance recorded using matching counters on separate off-map tracks as in Taylor's system is very confusing and time consuming in itself, so I have moved instead to a system in which each unit has just a single counter, whose placement and orientation display everything that matters in game terms.

As I said, the central focus of the simulation is on the impact of fighter range and endurance, so turns aloft must somehow be recorded by a less Procrustean means than in Lou Zocchi's 1971 game *Luftwaffe*, which famously required all aircraft of the same type to take off on the same turn so as to simplify record keeping![37] Since aircraft heading is immaterial in this operational game, I chose to make my unit counters into 'Pollard markers', by recording up to eight different fuel states depending on which side

of the counter is face up and which of its four edges is rotated to align with the top of the map.[38] This has the advantage that Luftwaffe counters (which have shorter range and so need only four different fuel states) can show the unit airborne on one side and in various stages of ground preparation on the other, obviating the need for special boxes as in the US base areas. Even eight different airborne states is an insufficient number to record the extended endurance of some of the longer ranged US fighters, and I did not want careless players to lose the game at a stroke by leaving whole groups with too little fuel to return home, so the US counters record only *outbound* endurance, and they are not rotated when returning towards their base. Aircraft range is a very complex variable, which depends on flight profile, internal fuel fitments and the number and size of drop tanks carried, and the sources contain some confusing and contradictory claims as to the figures involved.[39] Thankfully, examples of phased escort planning from shortly before and after Big Week give a clear enough sense of the practical reality to underpin appropriate limits in the simulation.[40] I model the possible premature release of half-full drop tanks before combat simply by ruling that units that still have an endurance of four or more have their endurance reduced to three when they engage the enemy. (Minimising this inefficiency was another advantage of phased escort tactics.)

Three sources in particular give very useful timelines for 25 February itself, and so help in structuring the simulation. One is Schmid's account of the German perspective, which describes the Eighth Air Force bombers crossing the coast at Dieppe at 1110 at the same time as the Fifteenth Air Force entered Austria at Klagenfurt.[41] Schmid says that the Fifteenth Air Force bombed Regensburg at 1300 and the Eighth Air Force left its targets and turned for home around 50 minutes later, and he goes on to describe waves of escorts crossing the coast to join the bombers, with one fighter formation entering Belgium at 1405 and meeting the returning bombers over Mannheim at 1445.[42] The second valuable source is Caldwell's war diary of Jagdgeschwader 26, which took off between 1050 and 1130, engaged the bombers over France and the German border, and then landed and scrambled again at 1430 to intercept the withdrawing raiders.[43]

The third useful source is the history by Fry and Ethell of the US 4th Fighter Group, which flew its last ever P-47 escort mission on 25 February before converting to P-51s. The group took off from Debden at 1103, met the outbound bombers near Sedan at 1220, left them near Stuttgart at 1302, and landed back at base at 1425.[44] In game terms, the unit would take off on the 1100 turn, fly three hexes onto the board on the 1130 turn (reducing its endurance to four), fly a further three hexes to catch up with the bombers on the 1200 turn (reducing its endurance to three), fly two more hexes with the bombers on the 1230 turn (reducing its endurance to one after fighting some German interceptors), fly homeward at three hexes per turn on the 1300 and 1330 turns (so keeping its endurance at one), and move off the board and land on the 1400 turn.

One reason why Taylor's game keeps unit details on off-map tracks is to allow the US player to conceal and misdirect his German opponent as to the actual plan, by using extra formations as dummies and feints. This played a significant role on 25 February, with the whole of the 1st and 2nd fighter divisions in northern Germany being tied down by a small force of B-24 Liberators and Mandrel jamming aircraft over the North Sea, and with the strongest *Gruppe* of the 4th fighter division in northern France being sent not against the heavy bombers passing directly overhead, but instead against a simultaneous raid on Dutch airfields by B-26 medium bombers.[45] William Wyler's original 1944 film *Memphis Belle* includes a wonderful cartoon sequence illustrating such deception tactics, and I show the sequence to my students at the start of the class to make the point.[46] However, it is very hard to model this intelligence contest directly in my own simplified simulation, not least because it is clear from the outset what the US targets are. Hence, as I discussed in Chapter 7, I resort instead to abstract techniques to mirror the *effects* of US deception measures, which in this case simply involves forbidding German fighters to scramble unless US bombers are within a certain randomly determined radius of their base. I also prohibit German fighter units from ganging up to overwhelm weakly defended bomber formations, forcing them to spread their attacks realistically among multiple formations if they do manage to take

to the air in strength. The concomitant restriction is that US escorts cannot gang up on German interceptors, since numerical superiority was far less effective in aerial combat than Lanchester predicted, for reasons I discuss in Chapter 11.[47]

Historically, the US lost around 70 bombers and seven escorts during the day, with many more aircraft damaged, while the Luftwaffe lost around 50 fighters and 20 pilots and suffered significant (albeit temporary) disruption to its aircraft production.[48] My combat system focuses entirely on interceptors attacking bombers and escorts attacking interceptors, and it handles more marginal factors such as flak and US escort losses simply by imposing an automatic attritional surcharge on the US forces at the end of the game.[49] Since there are only around a dozen air combats in each contest, I use the same die roll for both sides in order to reduce the impact of random variation. This covariance of losses makes sense, since the more aggressive the interceptors are in pressing home their attacks, the more exposed they are to the gunfire of the bombers and the counterattacks of the escorts. Twin-engined Me110 ‘destroyers’ are very effective against the bombers but horribly vulnerable to the escorts, so I have tweaked the combat modifiers in their case to reflect this trade-off more clearly.[50] The Me110s can exploit their greater internal fuel reserves by automatically scrambling when the Fifteenth Air Force bombers reach nearby Regensburg and then attacking them for up to three turns (as against the maximum of two turns for which other German interceptors can fight before having to return to base). This encourages the Fifteenth Air Force to use its scarce escorts to cover the withdrawal of the bombers and to frighten away the destroyers, exactly as happened in reality.[51]

US players are given very little discretion over the movement of their bomber fleets, since otherwise they can exploit the endurance of the bombers to react unrealistically to enemy fighter threats, and they may decide to cancel the historically very costly Fifteenth Air Force mission to Regensburg altogether. However, the US teams still face some very tough decisions over how to manage their escort provision to provide the best protection for the bombers across the mission as a whole, while the German players face equally hard choices over when to try to scramble

their fighters so as best to exploit windows of opportunity, and whether to pursue vulnerable bombers as far as possible or to return to base in good order to prepare for a second sortie. The game offers a wonderful comparative study of the ordeal suffered by the initially unescorted Fifteenth Air Force bombers compared to the better escorted Eighth Air Force bombers, and this single day of raids encapsulates in miniature many of the key dynamics of the entire daylight bomber offensive in 1943–44. As before, I will now set out the full rules so that you may try the simulation for yourselves.

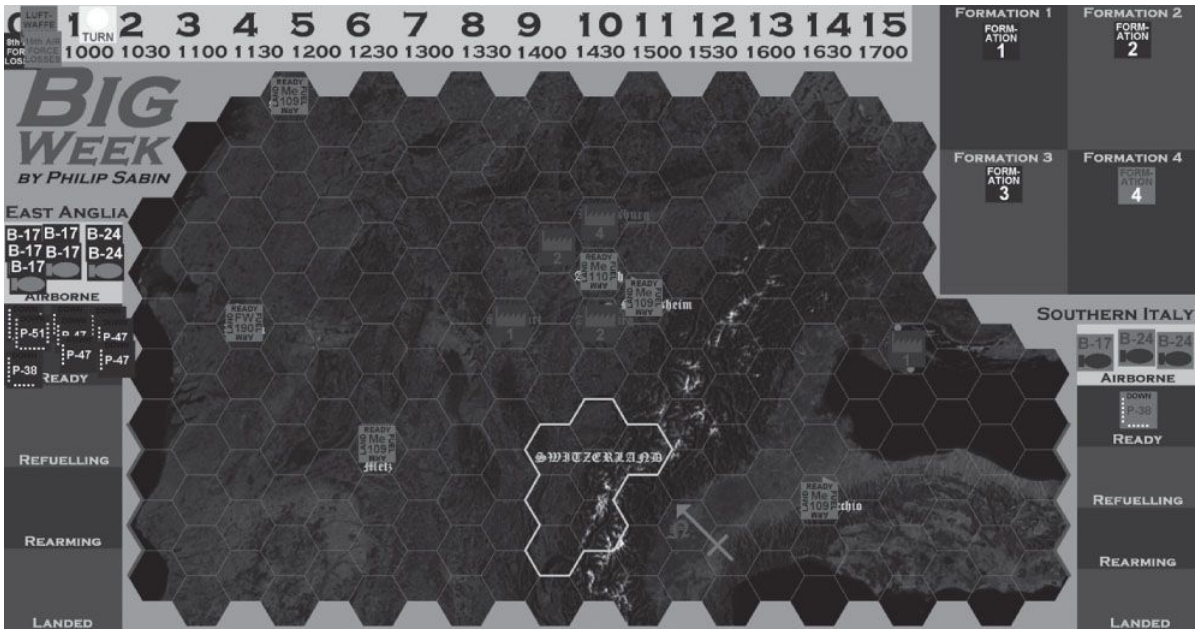
BIG WEEK

INTRODUCTION

This is a simulation game of US strategic bombing raids from England and Italy on 25 February 1944, the last day of the ‘Big Week’ offensive. Two or three players or teams direct the actions of the opposing air forces as they seek to inflict more damage than they suffer in this attritional contest. The simulation may also be played solitaire to study the dynamics involved.

THE MAP

Action takes place on a map of the battle area, as shown in Figure 10.1.



10.1 *Big Week* map

The map is covered with a hexagon grid, with each hex representing an area 45 miles across. Hexes may contain German bases (shown in blue) or targets (shown in red). The underlying terrain on the map is immaterial, except that neither side's units may ever enter neutral Switzerland. All units on the map must occupy a specific hex. If there are several US units in a hex, they may be replaced by a single formation counter while the units are placed in the corresponding box on the top right of the map, for ease of play. The US units possess two off-map base areas – East Anglia and southern Italy. Each base area consists of several boxes showing the status of the units therein. Units move to and from each base area via the four marked hexes on the adjacent map edge.

THE PLAYING PIECES

Each side has a number of units, each representing around 100 aircraft mainly of the type shown on the counter. US units may be bombers or escort fighters. The bombers may be B-17s or B-24s, but the difference is immaterial for game purposes. When bombers attack a target, their counter is flipped to its reverse side to show that they have delivered their bombs. Escort fighters may be P-47s, P-38s or P-51s. The dots around the edges of these counters show how much endurance that unit has remaining. Escort counters must be flipped to the appropriate side and rotated so that their remaining endurance is shown on the top edge of the counter, nearest to the top track (as shown later in Figure 10.2). The four light brown US units belong to the Fifteenth Air Force, and their home base is southern Italy. The other sixteen dark red US units belong to the Eighth and Ninth Air Forces, and their home base is East Anglia.

The six blue-grey German units are all interceptors. They may be Me109s, Me110s or FW190s. One side of the counter shows the unit airborne, and displays its current endurance as with US escort fighters. The other side of the counter shows the unit on the ground, and displays its state of preparation for taking off (corresponding to the different boxes in the US base areas). There are also numbered markers to show the position of large US formations, and markers to show the number of targets remaining in each target hex. Finally, there are markers for use on the top track to show the current turn and the number of hits suffered by the Luftwaffe, the Fifteenth Air Force, and the Eighth Air Force.

SEQUENCE OF PLAY

The simulation is played in turns, each representing half an hour of real time from 1000 to sunset at 1730. The current turn is shown by moving the turn marker along the top track. Each turn proceeds through four phases:

1 bombing phase
2 US movement phase
3 German movement phase
4 air combat phase.

BOMBING

During each bombing phase, US bombers occupying a target hex are automatically flipped over to show that they have dropped their bombs. Each unit that bombs reduces the number of remaining targets in the hex by one (as shown by flipping, replacing or removing the numbered target marker in the hex). Once all targets in the hex have been hit, additional bombers retain their bombs for use elsewhere. Note that the total number of targets in all target hexes exactly matches the number of bomber units in the game (ten), so US players have no choice but to attack all the targets with the matching numbers of bomber units.

MOVEMENT

In their side's movement phase, players move their units in any desired order. Airborne fighter units may remain in place or move up to three hexes in any direction or combination of directions. Bomber units may remain in place or move up to two hexes in any direction or combination of directions, subject to the constraints outlined below. Units may freely pass through hexes containing other enemy or friendly units, but Fifteenth Air Force units may never end the US movement phase in the same hex as Eighth or Ninth Air Force units, and no more than four bomber units and/or one airborne German unit may end their movement phase in a single on-map hex. Escort fighters and units on the ground or in US base areas do not affect stacking restrictions. Note that two German units may only ever end their move in the same hex if one is airborne and the other is on the ground. Formation markers are simply for convenience, and individual US units may enter or leave them as desired.

Bombers that have not yet dropped their bombs must end each move either two hexes closer to the hex with the highest number of remaining targets (the US player's choice if there is a tie), or occupying a target hex in which they will drop their bombs next turn (so not in excess of the remaining targets in the hex). Bombers may be moved freely on the turn in which they drop their bombs (to allow them to reform and prepare for withdrawal), but on all subsequent turns they must end their move two hexes closer to their base area than they began (traced via the closest entry hex). These constraints force bombers to move directly and speedily to and from their targets, while still leaving US players some discretion as to their precise routes.

AIRFIELD OPERATIONS

Bombers begin the game in the ‘airborne’ boxes of their base areas, forming up ready for their raids. Fifteenth Air Force bombers must all enter the map on the 1000 turn, and Eighth Air Force bombers must all enter the map on the 1100 turn, using any entry hexes as long as they all end up two hexes closer to Regensburg. US escorts which begin a turn in the ‘ready’ box of their base area may take off and move to the ‘airborne’ box at the player’s discretion. US escorts that begin a turn in the ‘airborne’ box must move onto the map that turn. US units enter the map via any of the designated map edge hexes, treating this hex as their first hex of movement. US units leave the map in a similar way, moving into one of the entry hexes and then using one extra hex of movement to leave the map and move to the ‘landed’ box of their own home area, with their ‘down’ edge uppermost. During each subsequent US movement phase, landed escort fighters automatically move one box upward, from ‘landed’ to ‘rearming’, from ‘rearming’ to ‘refuelling’, and from ‘refuelling’ to ‘ready’, so after three complete turns on the ground, they may take off once again. Bombers remain in the landed box.

German interceptors all begin on the ground in a base hex with their ‘ready’ edge upright. During any German movement phase, players may roll a die for an interceptor unit that started the turn ready, and if the score at least equals the distance in hexes to the nearest on-map bomber unit (counting the bombers’ but not the interceptors’ hex), the unit takes off and is flipped to its airborne side. Any or all units may attempt take offs in any order. Units may move only up to one hex on their take off turn, to reflect the time needed to form up and climb to altitude. Interceptors may land at any base not already containing interceptors on the ground, by ending their move in that hex and flipping their counter so that the ‘land’ edge is upright. The counter is then automatically rotated 90° clockwise through ‘arm’ and ‘fuel’ to ‘ready’ in each subsequent German movement phase, so that after three complete turns on the ground, the unit is ready to take off again as with escort fighters. Alternatively, airborne German units may simply be removed permanently from play during any German

movement phase, representing their landing safely at scattered airfields but being incapable of launching another sortie that day.

ENDURANCE

Bombers have unlimited endurance in game terms. Fighters end their take off move with their counter showing the maximum endurance available to that aircraft type. This is seven for P-51s, six for P-38s, five for P-47s, and four for all German interceptors. In each subsequent friendly movement phase, the unit ends its move by rotating its counter 90° clockwise (or flipping it if necessary) to reduce its remaining endurance by one, remembering to do this even if the unit is in a formation box. The exception is that US fighters that end their move at least three hexes closer to their own base area (traced via the closest entry hex) do not suffer this reduction, neither do US fighters that end their move at least two hexes closer to their own base area on turns ending in ‘30’ rather than ‘00’. Hence, with careful planning they can escort homebound bombers for a while before having to break off and head directly for home themselves.

Fighters with an endurance of one play no part in air combat, and the only thing they can do is to land and prepare for another sortie. US fighters that start their move with an endurance of one must either land at or move three hexes closer to their own base area (traced via the closest entry hex). German fighters that start their move with an endurance of one must either land at an empty base that turn or land at scattered airfields and be removed from play. Fighters may use higher throttle settings and increase their movement by one hex on any turn, at the cost of reducing their endurance by an extra one (even for homebound escorts). US escorts may not use fast movement on their take off turn, but German interceptors may do so in order to move two hexes rather than one when they take off. Either side’s fighters may use this option to increase their movement on the turn in which they land, as long as they do not start the move with an endurance of one.

AIR COMBAT

During the air combat phase, combat is resolved in all hexes that contain one or more bomber units and an airborne German interceptor unit with an endurance of two or more. Combat never occurs in hexes containing only fighters or a German unit with an endurance of one. German players decide which combats to resolve first if there are two or more combat hexes. Escorts and interceptors other than Me110s automatically have their remaining endurance reduced to three when combat occurs in their hex, because of having to release half-full drop tanks. Combat is resolved automatically, and units may not be held back from the resolution process.

Combat involves rolling a single die for each hex, with the same score being used by both sides as their basic combat factor. Interceptors add one to their combat factor if they are FW190s or Me110s. They deduct one (or two for Me110s) if there are at least half as many escort units with an endurance of two or more as there are bomber units in the hex. If the interceptors' modified combat factor is two, three or four, one hit is recorded on the appropriate US bomber force, while if it is five or more, two hits are recorded. The US units add two to their combat factor (or four if fighting Me110s) if there is at least one escort unit with an endurance of two or more in the hex. If the modified US combat factor is five or more, one hit is recorded on the Luftwaffe, and the German unit in the combat has its endurance reduced to one. Hits are recorded on the top track, with each hit representing around five bombers or ten interceptors destroyed or badly damaged. Hits on the US forces never affect escort fighters or the ability of the bombers to attack their targets, and they have no game impact except for victory purposes. However, if the unmodified combat die roll were 3 or 4, then the US must choose one escort unit with an endurance of two or more (if any are present in the hex) and reduce its endurance to one because of ammunition shortages.

VICTORY

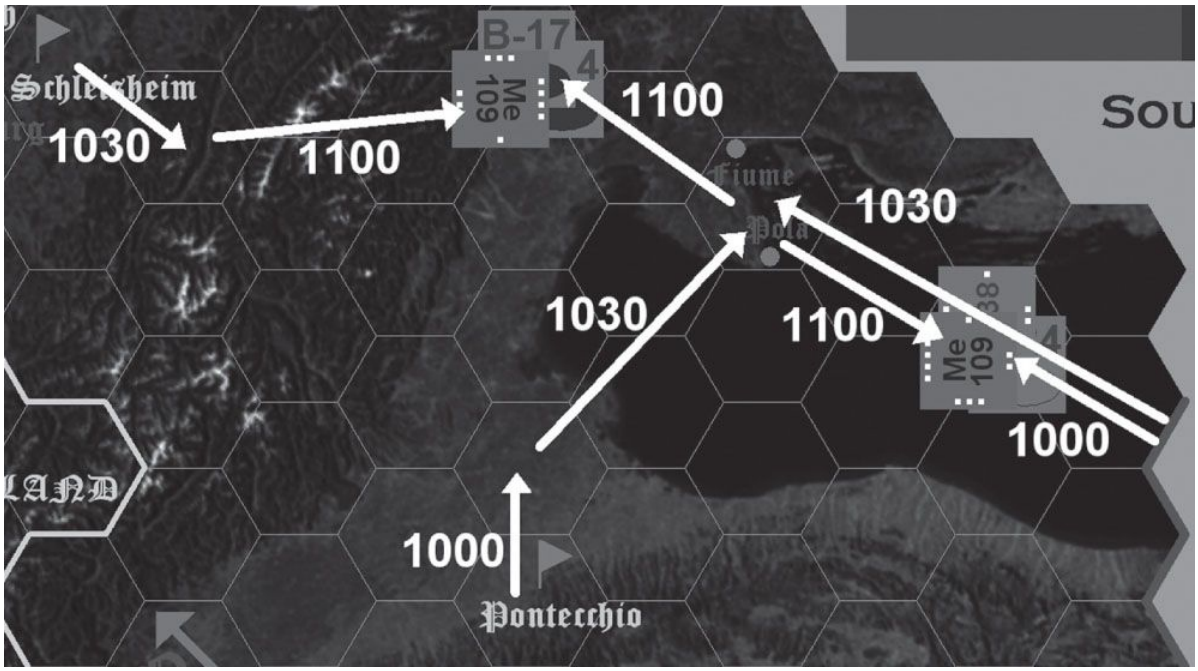
At the end of the 1700 turn, the sun sets, and the US forces lose if any US units are still airborne. Otherwise, the Fifteenth Air Force suffers one extra hit and the Eighth Air Force suffers two extra hits, to reflect sporadic losses caused by flak, accidents, and fighter vs fighter combat. Each side now scores one victory point for every hit suffered by the enemy, and the US scores one victory point for each of the ten targets removed. The side with more victory points wins, with the margin reflecting the degree of the victory. If the scores are equal, both sides have matched their historical performance.

INITIAL SETUP

Target markers are placed to show four targets in Regensburg, two each in Fürth and Augsburg, and one each in Stuttgart and Pola/Fiume. The Germans place a ready FW190 unit in Deelen, a ready Me110 unit in Ansbach, and ready Me109 units in Stade, Metz, Schleisheim and Pontecchio. Five B-17 units and two B-24 units of the Eighth Air Force are placed in the airborne box of East Anglia, while six P-47 units, two P-51 units and one P-38 unit of the Eighth and Ninth Air Forces are placed in the ready box of East Anglia, with their ‘down’ edges uppermost. The Fifteenth Air Force places one B-17 and two B-24 units in the airborne box of southern Italy, and one P-38 unit in the ready box of southern Italy. The turn marker is placed in the 1000 box of the track, and the loss markers for the Luftwaffe, the Fifteenth Air Force and the Eighth and Ninth Air Forces are all placed in the 0 box of the track. The four US formation markers are placed in their corresponding boxes, ready for use as required.

EXAMPLE OF PLAY

The 1000 turn begins with the three Fifteenth Air Force bomber units required to move two hexes towards Regensburg in the US movement phase. As shown in Figure 10.2, they move together through the most easterly hexes available along the Adriatic, so as to maximise the distance from the enemy's fighters in Italy and so as to pass directly over the initial target at Pola/Fiume. (The bombers could not veer even further eastward over Yugoslavia, since this would leave them only one hex closer to Regensburg with its four targets.) The P-38s in southern Italy are scrambled, and are moved to the airborne box and rotated to show their maximum endurance of six, ready to join up as escorts in a future turn. In the German movement phase, the fighters in Italy opt to try to scramble. The range from Pontecchio to the US bombers is four hexes, so on a die roll of 4, take off is just permitted. The interceptors move one hex east, and are flipped and rotated to show their maximum endurance of four.



10.2 *Big Week* example

On the 1030 turn, the bombers could dogleg left and still come two hexes closer to Regensburg, but they opt instead to maintain their course over Pola/Fiume. The P-38s could not reach them

from southern Italy with a normal three hex move, but because of the imminent prospect of interception, they undertake a fast four hex move instead and end up accompanying the bombers with their endurance reduced by two points to a level of four. In East Anglia, two P-47 units take off ready to provide the initial escort for the Eighth Air Force raids. The German fighters over the Po valley need only a three hex move to reach the bombers, and they do so with an endurance of three. The Me109s across the Alps in Schleisheim are also now just close enough to the bombers to try to scramble if desired, and on a die roll of 6 they get lucky and are able to take off and move one hex south with an endurance of four. In the air combat phase, the endurance of the P-38s falls to three as they drop their tanks early. The combat die roll is 2, and with no modifiers in effect for the Germans because there are over twice as many bomber as escort units in the hex, this means that one hit is recorded on the Fifteenth Air Force. The US forces get a +2 modifier for the presence of the P-38s, but this only brings their combat factor to 4, so the Luftwaffe remains unscathed for now.

The 1100 turn begins with the bombing phase. One of the B-24 units is flipped over, and the target marker in Pola/Fiume is removed. In the US movement phase, the other two bomber units must fly two hexes onward, and they continue to take the most eastward route permissible. On this one turn, the empty B-24s have complete freedom to move in any direction, and they could even accompany the other bombers so as to prevent both the airborne German fighter units getting the chance to attack this turn. However, they instead move straight back towards southern Italy, ready to exit the map next turn. The P-38s now have only one turn of useful escort time left if they continue northwards, so instead they move back with the returning bombers in order to get home a turn faster and so shorten the time before they can sortie again to protect the withdrawal of the main force. (They could have got all the way home this turn using fast movement and so saved yet another turn, but this would have left both bomber forces unescorted.) Since the P-38s are moving only two hexes closer to their base and the turn ends in ‘00’ rather than ‘30’, their endurance falls to two.

Over in East Anglia, three B-17 units from the 1st Bomb Division move two hexes onto the map via the westernmost entry

hex around Dieppe, heading for the three targets in Stuttgart and Augsburg (although still constrained to move two hexes closer per turn to the main target concentration in Regensburg until some of its targets are hit or they can end their move over their own targets). Stacking limits prevent more than one other bomber unit following this path, so the two B-24 units of the 2nd Bomb Division and the two B-17 units of the 3rd Bomb Division instead enter over the Pas de Calais and end their move one hex to the northeast of the 1st Bomb Division. They can still reach their respective targets of Fürth and Regensburg on the 1330 turn, and flying this way rather than taking the direct route over Belgium has the advantage that their flight path is far enough away from the 2nd Fighter Division around Hamburg that there is no chance of its being able to take off until they briefly come within six hexes over Fürth itself. The two airborne P-47 units must enter the map this turn, and they move two hexes to accompany each bomber stack, with an endurance of four. (The two stacks may be replaced by formation markers and the units transferred to the matching off-map boxes, for ease of play.) Two more P-47 units take off ready to catch up and take over outbound escort duties on the 1200 and 1230 turns (as the 4th Fighter Group did historically). The other two P-47 units are held back ready to provide withdrawal escort on the first part of the return flight, until other P-47s flying their second sortie can relieve them.

In the German movement phase, the fighters around Metz roll a 5 and so may take off and move one hex towards the massed bomber streams four hexes away, but the more dangerous FW190s around Deelen roll a 3 and so are unable to take off this turn. The Me109s from the 7th fighter division move three hexes across the Alps to intercept the main Fifteenth Air Force bomber force over Klagenfurt (just as happened historically), and their endurance falls to three. Because only one German unit is allowed per hex, this leaves the Italy-based fighters the choice of either pursuing the empty bombers southwards or flying back to base using fast movement and preparing for a second sortie. They choose the first option and move after the retreating bombers, reducing their endurance to two. The Me110s in Ansbach could take off if they were to roll 5 or 6, but they decide instead to wait to see how long the Me109s can sustain the fight against the

unescorted enemy main force. In the air combat phase, this battle is resolved first, and on a roll of 3 with no modifiers in effect for either side, one hit is scored on the bombers while the interceptors remain unscathed. In the south, the roll of 4 is reduced to 3 for the interceptors because of the 1:1 ratio of escorts to bombers, and increased to 6 for the US because of the escorts' presence. Both sides hence suffer one hit, and the two fighter units have their endurance reduced to one because of damage and ammunition shortages. This is immaterial to the P-38s, but it is bad news for the German fighters since they cannot reach their base next turn using normal movement and so will have to land at scattered airfields and forego a second sortie. However, four of the six German fighter units remain well positioned to inflict further losses on the converging bomber fleets, especially the Fifteenth Air Force since their fighters cannot take off again until 1330 and so will be unable to provide escort until the bombers reach the Adriatic on their return journey.

In my second year BA course on World War Two, I need a similar operational level simulation to illustrate the dynamics of land warfare. My *Second World War* and *Eastern Front* games are so simple and broadbrush that they do not even directly model the difference between infantry and armoured formations and the way in which the latter were often able to 'pocket' enemy troops, cutting off their lines of supply and retreat. Hence, I use a third, much more focused simulation as a 'case study' to back up the four classes in which we analyse the often complementary dynamics of fast moving *Blitzkrieg* operations and of bitter attritional assaults reminiscent of those in 1914–18. The different phases of the Stalingrad campaign in 1942–43 exemplify these complementary dynamics very well, with the rapid Axis advance slowing down in the face of bitter Soviet resistance in the rubble of the city itself, and the bloody and prolonged struggle there setting the Sixth Army up for encirclement by a swift Soviet pincer movement from both flanks.[52] Although I could have chosen to model this famous battle itself, I decided to let the students research it from the abundant conventional literature, and to focus our simulation exercise instead on a smaller and less well-known pocket battle that was typical of the encirclements suffered by Axis forces during their

long retreat in the east in 1944–45.[53] The finely balanced fighting in January and February 1944 around the small Ukrainian town of Korsun (80 miles south of Kiev and 35 miles west of Cherkassy) fits the bill very well. It encompasses attacks and counterattacks by both sides' armoured forces (including over half the Tiger and Panther tanks on the Eastern Front), aerial resupply by the Luftwaffe, the stultifying impact of the weather, and militarily questionable directives from Hitler himself.[54]

Even though the battle at Korsun is much less famous than the earlier epic clashes at Moscow, Stalingrad and Kursk, it is still the subject of several published boardgames and one highly praised computer simulation.[55] As usual, the problem with using these games directly in class is that even the simpler ones are still far too complex, detailed and time consuming for non-wargamers to play in the limited time available. Jack Radey's pioneering simulation from 1979 is a 'monster' that uses four big maps and no fewer than 2400 counters and the 2003 computer game is on a similarly detailed scale, with many thousands of hexes and a 40-page rulebook.[56] Hence, as with Taylor's *Bomber* game, I needed to design my own smaller and simpler version if I were to have any hope of making the simulation sufficiently accessible. Fortunately, unlike with Big Week, there are a number of recent forensic analyses of the Korsun battle, which make researching the many military details needed to underpin even a simple game model far easier than it was hitherto. In 2003, Glantz and Orenstein translated and published the original Soviet General Staff Study of the engagement, and they complemented this with a series of 27 maps showing how force dispositions on both sides evolved on a daily basis – exactly what is needed to construct the 'storyboard' that I discussed in Chapter 6.[57] Two years later, Nash published the second edition of his book *Hell's Gate*, which gives a very detailed account of the battle based on interviews with German veterans, and which takes its title from the nickname given to the village of Shenderovka where the pocket was concentrated just before the breakout attempt.[58] Finally in 2008, the Swedish operational researchers Zetterling and Frankson, who had earlier published an insightful statistical analysis of the battle of Kursk, produced an equally informative research study of the Korsun

campaign.[59] Along with various chapter-length accounts of the battle, this all builds up into quite a detailed record of what was previously a rather obscure engagement.[60]

As I discussed in Chapter 5, around two dozen counters per side is the maximum practical limit if a game is to be completed within a two-hour class. I thus decided that each counter would have to represent a German division or a Soviet corps (the two being roughly equivalent in fighting power). However, it soon became clear when researching the battle what a huge difference there was between the density of forces when massed for attack and when spread out in defence. The initial offensive by Konev's Second Ukrainian Front involved the 53rd Army, 4th Guards Army and 5th Guards Tank Army with a total of around 122,000 troops attacking the eastern face of the salient on a frontage of just 45 km, while the First Ukrainian Front's 27th Army with only around 28,000 troops held a front of nearly 100 km on the north and west of the salient. Not only that, but the 27th Army still managed to concentrate two of its divisions on its far right flank to join the 58,000 troops of the neighbouring 40th Army and 6th Tank Army in forming the second prong of the Soviet pincer movement, leaving just one rifle division and two 'fortified regions' to garrison the rest of its 100 km front.[61] To handle this gross variation in force densities, I opted to use the technique outlined in Chapter 5 of having counters on the thinnest held parts of the front represent smaller units such as Soviet divisions or German regiments, brigades or *Kampfgruppen*, with these units possessing only a single step whereas normal size units have two steps (shown by flipping the counter over). The Germans employed several independent sub-divisional units in their counterattacks (such as Panzer Regiment 26 and Panzer Regiment Bäke), but rather than representing these too by separate counters, I fold most of them into the panzer divisions that they accompanied, to prevent counter numbers becoming impractically large.[62]

Both sides' units in this battle were understrength because of losses suffered in earlier fighting, so it is important to use their actual recorded strength rather than relying on theoretical tables of organisation and equipment. I use a very rough yardstick of awarding one strength point for every 4000 to 5000 troops, and so

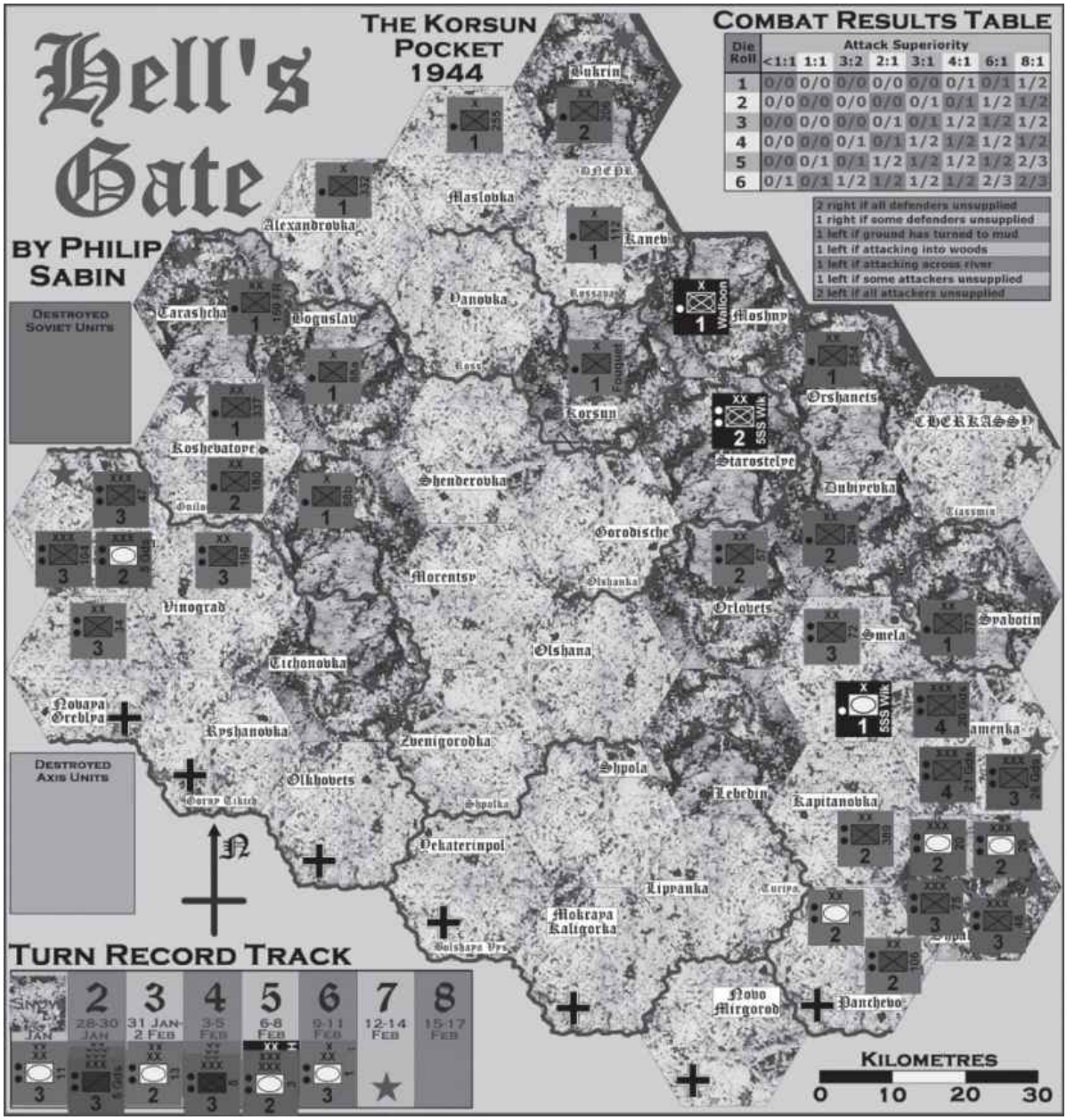
I give stronger or better motivated units such as the German 34th and 72nd Infantry Divisions and the Soviet 20th and 21st Guards Rifle Corps a higher strength rating than other units.[63] Apart from a few mechanised and cavalry units, the forces in this battle consisted either of leg infantry or of armoured formations in the shape of German panzer divisions or Soviet tank corps. The infantry was best suited for defence, while the armour was most useful for attacks. To reflect this difference in roles, I rule that all units use their printed combat strength in defence, but that armoured units double or treble their combat strength when attacking (depending on the nature of the terrain). This neatly counterbalances the impact of basing the printed strength of armoured units mainly on their manpower numbers, and it allows me to represent the key armoured unit within the pocket (the 5th SS Wiking division) by two counters rather than one, to allow the panzers themselves to be detached and used as a 'fire brigade' to bolster other units, exactly as happened historically. Both sides fed in numerous reinforcement units as the battle progressed – this is reflected by having such units appear at the historical times and locations, and by allowing the Soviets to rebuild two lost steps later in the game. The 5th Mechanised Corps took part (rather ineffectually) in the initial assault by Vatutin's First Ukrainian Front, but was then withdrawn temporarily to counter a German counterattack to the west – for simplicity's sake, the unit's mechanised infantry appear later in the game as a reinforcement, but its tanks are used from the outset to bolster the otherwise badly depleted 5th Tank Corps, allowing that unit to spearhead the breakthrough as happened in reality.[64]

Existing simulations of Korsun mostly use fine hexgrids, with hexes representing only a few kilometres across. As I discussed in Chapter 5, ZOCs are the standard way of maximising grid resolution while still allowing thin screening forces like those of the 27th Army to maintain a coherent front. However, as I pointed out then, ZOCs involve several abstractions, especially when trying to simulate the winding and indented battlefronts that developed in this engagement as the Germans carved out narrow salients in their efforts to rescue their surrounded forces.[65] Hence, as in my *Eastern Front* game, I decided to do without ZOCs and instead to

use larger hexes, each representing an area some 20 kilometres across. The thinly held Soviet front on the north of the salient is left partly off the map, although, unlike in some other simulations, I do include the entire German perimeter, to give students a clearer sense of the overall picture.[66] To supplement the numerous maps in the historical sources, I took several screen grabs from Google Earth satellite images of the battle area, patched them together to give a detailed overall image, and highlighted the historical frontline and the course of the key rivers. I then used *Cyberboard* as described in Appendix 4 to overlay onto the image a hexagon grid of the appropriate resolution, and I tweaked the positioning of the grid and the course of the rivers and the frontline to make these features run along hexsides for game purposes. The satellite image was particularly useful in deciding which hexes should contain wooded terrain, since this is rarely clear from the historical maps. However, unlike with my other simulations, I did not use the satellite image as the background for the actual game map. Instead, I employed a freely reusable NASA image of snow-covered Poland as a source for more generic images of clear and wooded terrain, and I pasted these in various orientations into each individual hex, thereby giving a much clearer portrayal of how the rivers and woods conform to the hex grid (as shown in Figure 10.3).[67] As in *Eastern Front*, I use the names of actual towns rather than an artificial numbering system to identify different hexes, so allowing a much clearer correspondence between the simulation and the historical accounts.

A major advantage of large hexes is that they allow attackers to advance a significant distance just by taking one frontal hex. Storyboarding this engagement using eight 3-day turns reveals that infantry units rarely moved or advanced more than one hex per turn once in the battle area, and that the more mobile cavalry, mechanised and armour units did so only in the first few turns before the unusually early spring thaw bogged both sides down in the famous Russian *rasputitsa*.[68] Hence, the movement system can be as simple as allowing all units to move one hex per turn in any direction, and allowing cavalry, mechanised and armour units to move two hexes per turn while the ground remains frozen. These limited movement allowances abstractly reflect the fact that

even apparently empty hexes could contain small garrisons that could hold up an advance. I pointed out in Chapter 6 that a ‘fight–move’ sequence for each side is generally more problematic than a ‘move–fight’ sequence, but with large hexes and no ZOCs it is less of an issue, since units can attack in different directions without moving from their initial hex, and since defenders cannot afford to abandon entire hexrows in order to avoid attack. A ‘fight–move’ sequence has the advantage that advances after combat can occur using the normal rules of movement rather than requiring special additional rules, so I decided to use such a system in this case given the heavily attritional and positional nature of the fighting after the initial Soviet encirclement.



10.3 *Hell's Gate* map

One key concept I stress throughout my World War Two course is that of force-to-space ratios (as discussed in Chapter 6 and illustrated in Figure 6.1).[69] A major educational objective of the Korsun simulation is to help the students to understand the fundamental trade-off between massing forces for increased combat effectiveness (whether attacking or defending) and spreading troops more thinly to guard an extended front. Dunnigan points out that German infantry divisions pursuing defence in depth by keeping one-third of their subunits at each organisational level in reserve would hold a front of just six kilometres, but that this

could be extended to 40 kilometres by putting every single platoon in the frontline.[70] The Germans start out very thinly stretched in defending the long front of the Korsun salient, and so are fairly easily pocketed by the massed Soviet pincers, but once the encircled troops pull back into a shorter perimeter, they are able to defend themselves more effectively despite the shortage of supplies, and the boot is on the other foot as the encircling Soviets need to defend a long front against concentrated relief drives by the reinforcing panzer divisions. I allow unlimited stacking in the game, because the 50,000 or so pocketed Germans ended up crammed into a tiny six by eight kilometre area at Shenderovka just before the final breakout.[71] However, I make such excessive force concentrations highly vulnerable to artillery fire, and I impose realistic limits on how many units can effectively defend a hex or attack across a given hexside. Hence, the Soviets cannot stop a linkup with the pocket simply by massing as many units as possible in front of the panzer spearheads, but must also attack the panzers from the flanks to reduce the momentum of their drive.

I use a ratio-based combat system, and I allow the attackers either to launch a cautious offensive at little cost to themselves or a more effective all-out attack at the cost of losing one of their own steps. This loss must be taken from a full strength armoured unit if available, to reflect the heavy tank losses that attackers often suffered.[72] A simple CRT combines the combat ratio, the attack type and a random die roll to generate defender losses, and the results are based on the observed outcomes of various attacks that took place in the real battle. For example, I have given Vatutin's main initial all-out attack on the 198th Infantry Division a 50 per cent chance of achieving a breakthrough and a 33 per cent chance of only causing a matching step loss, while the more limited secondary attack by the two flank divisions of the 27th Army has a 33 per cent chance of driving back the weaker and more thinly stretched 88th Infantry Division. Historically, only the secondary attack achieved a breakthrough (which the tank forces were then diverted to exploit).[73] This example illustrates very well how random variation in a simulation system can mirror unexpected outcomes in reality, without distorting players' actions by unduly privileging what hindsight reveals as the most effective

approach. Defenders can choose to absorb one loss by having their units retreat rather than stand and fight, so both sides have an important degree of choice over how bloody and fiercely contested each combat is. Units that retreat are forbidden to attack or move in their own ensuing player turn, to avoid back and forth combats becoming too common and to stop retreat becoming a ‘soft option’. For the sake of simplicity, I assume that the extra protection offered by fuller German entrenchments along the original frontline is counterbalanced by the availability there of massed Soviet artillery that could not easily be moved up to attack deeper targets later in the battle because of the pervasive mud.[74] The overall result of the combat system is that both sides gradually run out of intact two step units and so lose their offensive capability, producing a very realistic stagnation of the battlefront as exhaustion spreads and casualties and equipment losses mount.

As I said, another key aim of the simulation is to illustrate why pocketing enemy forces was such a characteristic feature of land operations in World War Two. Encircled forces in the game suffer significant combat penalties through lack of supply, although these penalties are mitigated somewhat by Luftwaffe supply flights to the Korsun airfield.[75] If the Soviets manage to maintain an intact inner and outer ring, then the pocketed troops are doomed, but if the relieving panzers get within two hexes of the pocket (usually by taking Vinograd while their encircled comrades crowd into Shenderovka), then the stage is set for a messy and costly breakout through the Soviet lines as happened historically.[76] Hence, Soviet players must carefully balance the forces they devote to the outer and inner rings of the encirclement, in order to keep the panzers at bay while also inflicting losses on the pocketed troops and pushing them further out of reach. The Germans, for their part, must seek to create a ‘wandering pocket’ and drive towards safety without suffering undue losses or losing touch too early with the Korsun airhead.[77] The advent of mud is a double-edged sword, since it makes it easier to defend the pocket but harder to break through to it. Conventional writing on the battle tends to dwell rather mawkishly on the individual experiences of German troops and their fascist allies as they struggled to free themselves from the Soviet trap, but game designer Jack Radey

has no sympathy for their plight, and he suggests that only 10–20,000 of the 60,000 or so pocketed forces escaped, rather than the 40,000 claimed by German sources as having broken out or been flown to safety.[78] This is a very telling corrective to any suspicion that wargamers are closet Nazi sympathisers, blind to the moral aspects of the conflicts they seek to model.[79]

The Korsun pocket might not have been created at all had German generals been able to persuade Hitler to withdraw beforehand from this exposed salient and to give up his last toehold on the River Dnepr. I impose severe constraints on German freedom of movement on the first few turns to reflect the continuing impact of this politically driven inertia in the face of the Soviet surprise attacks.[80] The other counterfactual question sometimes raised about this battle is whether the Soviet spearheads should have turned south after their initial breakthrough and exploited the gap they had torn in the German line to drive towards the key base at Uman.[81] However, they were wary of overextending themselves as at Kharkov the previous spring, and the simulation makes clear that their bloodied spearheads were scarcely sufficient to hold the inner and outer rings, let alone to create their own vulnerable salient to the south and risk being encircled themselves by German counterattacks from the ‘shoulders’ of the penetration.[82] Historically, Hitler ordered the 24th Panzer Division to turn back towards the crisis at Nikopol just as it was about to reinforce the Korsun battle, and in my game it will fight at Korsun after all if the Soviets raise the stakes by pushing south – a very neat and credible way of linking these two variables within the overall system.[83]

This simulation is probably at the limit of what it is practical to attempt in a class context. It contains significant historical detail, and although the basic rules system is pretty straightforward, there are quite a few active counters and a number of special rules, and it is all too easy for inexperienced players to make fatal tactical errors. This is where my approach of ‘guided competition’ comes into its own, by helping the students with the nuances of the rules and by allowing hints on the best tactics to adopt. As shown at the start of the colour plates, my teaching assistants use big three-feet-square maps to run three games simultaneously for the 30 or

so students, and since the command of the forces in each contest naturally falls into five distinct sections (the First and Second Ukrainian Fronts for the Soviets, and the Eighth Army, First Panzer Army and the pocketed troops under Stemmermann for the Germans), this gives each pair of students a distinct and challenging role to play. I base game victory on the number of steps lost by the two sides and on the number of board edge hexes captured, and this simply but effectively mirrors the priorities of the real antagonists in this bloody, confused and finely balanced engagement. As before, I will now present the full rules so that you may explore the simulation for yourselves, using the sixteen-inch-square map and large unit counters that may be assembled from the colour plates.

HELL’S GATE

INTRODUCTION

This is a simulation game of the battle of the Korsun pocket in Ukraine in January and February 1944. Two players or teams direct the actions of the German and Soviet forces as they seek to capture or regain territory and to inflict losses on the opposing forces while minimising their own losses. The simulation may also be played solitaire to study the dynamics involved.

THE MAP

Action takes place on a map of the battle area, as shown in Figure 10.3. The map is covered with a hexagon grid, and all units on the map must occupy a specific hex. Each hex represents an area 20 km across, and contains a named town or village or the city of Cherkassy. Most hexes contain clear terrain, but fourteen of them instead contain woods, as shown by the use of a more wooded background image. The River Dnepr runs along the northeastern edge of the map, and smaller rivers run along certain hexsides within the map.

Seven board edge hexes are marked with black crosses to indicate that they are German supply sources, and eight board edge hexes are marked with red stars to show that they are Soviet supply sources. The map also contains a combat results table, a turn record track, and boxes to hold destroyed units from the two sides.

THE PLAYING PIECES

Each side has a number of units, represented by single- or double-sided counters as shown in Figure 10.3. The box in the centre of the counter indicates the unit type, using the NATO symbology laid out in Figure 5.3. Unit type is also shown by the colour of the box, with green indicating infantry, yellow denoting tank or panzer units, and dark red showing mechanised infantry (with the cross and oval symbol) or cavalry (with the single diagonal slash). The colour of the rest of the counter indicates which side the unit is on. German units are grey except for four SS units, which are black, and Soviet units are brown except for five Guards units, which are red. SS or guards status has no game effect, and is purely for historical interest.

The symbol at the top of each counter shows the organisational size of the unit, with XXX indicating a corps, XX a division, and X a German sub-divisional unit such as a regiment, brigade, reinforced battalion, or ad hoc *Kampfgruppe*. The number and/or text on the right of the counter shows the historical unit designation, with ‘Fouquet’ and ‘Haack’ being *Kampfgruppe* commanders, ‘Wiking’ and ‘Leibstandarte Adolf Hitler’ being SS appellations, and ‘Walloon’ indicating the Belgian SS brigade. The dot or dots on the left of the counter show the number of steps in the unit. Single-sided counters (Soviet divisions and German sub-divisional units) have a single step, while double-sided counters (Soviet corps and German divisions) start off at two step strength, and are flipped to their reverse side, showing one full and one hollow dot, if they lose a step in combat. Units that lose their last step are placed in the appropriate box for destroyed units. The large number at the bottom of each counter shows its basic combat strength at that step level. There is also a counter to show the current turn number and prevailing weather conditions, and several smaller markers to identify units that have retreated.

SEQUENCE OF PLAY

The simulation is played in eight turns, each representing three days of real time. The current turn is shown by moving the turn marker along the turn record track. Each turn contains two player turns, with the Soviet player turn occurring first. Each player turn proceeds through three phases:

1 supply and reinforcement phase
2 attack phase
3 movement phase.

SUPPLY

The supply status of all units is judged during their own supply and reinforcement phase, and lasts until their next supply and reinforcement phase. Units are in supply if they occupy or can trace a supply line to a friendly supply source hex. Supply lines are chains of hexes of any length, but they may not be traced into or through enemy occupied hexes, or into or through vacant hexes that contain enemy supply sources or are next to enemy occupied hexes. Units found to be out of supply are rotated through 180° to record the fact. They may move only one hex per turn, and they suffer adverse column shifts in combat. If an unsupplied unit is found to be in supply in a subsequent friendly supply and reinforcement phase, it returns to normal and is rotated back to its normal orientation.

ATTACKS

In their attack phase, units may attack adjacent enemy occupied hexes. Attacks are voluntary, may take place in any order, and need only be declared as they occur. Retreated units may not attack. Each enemy hex may only be attacked once per turn, and each friendly unit may only attack one enemy hex per turn. Friendly units in the same hex may attack in different directions or not at all, and units in different hexes may combine to attack a mutually adjacent enemy hex in a single attack. A maximum of two units may attack across a given hexside, so units beyond the first two would have to attack different hexes or not at all. The attackers first declare which units are attacking a selected enemy hex, then resolve that attack, and then go on to declare and resolve attacks against other enemy hexes in turn. Units that attack may be rotated temporarily through 90° if desired, as a reminder that they may not attack again this turn.

Attacking tank or panzer units have their strength trebled if attacking a clear terrain hex, or doubled if attacking a woods hex or the city of Cherkassy. The strength of all the attacking units is added up and compared as a ratio to the combined strength of the strongest two Soviet or three German units in the hex under attack (or all the defending units if there are not that many). Retreated units are ignored and contribute nothing to the defence. The strength ratio is rounded in favour of the defenders to match one of the columns on the combat results table on the map. Players must then work out the net column shift, based on the combined impact of the following list of factors shown, and shift to the column that far left or right along the table (stopping if the leftmost or rightmost column is reached). For example, if units totalling twelve strength factors attack a single one strength factor unit that is unsupplied but is defending in a woods hex and behind a river during muddy conditions, the basic attack column is 8:1 and the two rightward and three leftward column shifts combine to yield one leftward shift, making the final column 6:1. The column shifts are as follows:

Shift 2 right if all of the unretreated units in the attacked hex are unsupplied.
Shift 1 right if some but not all of the unretreated units in the attacked hex are unsupplied.
Shift 1 left if the ground has turned to mud.
Shift 1 left if the attacked hex contains woods or the city of Cherkassy.
Shift 1 left if at least half of the attacking units are attacking across river hexsides.
Shift 1 left if some but not all of the attacking units are unsupplied.
Shift 2 left if all of the attacking units are unsupplied.

COMBAT RESULTS

Once the attack column has been determined, the attacker must decide whether to launch an all-out attack. To do so, one attacking two step unit of the owner's choice (which must be a tank or panzer unit if possible) is flipped to its one step side. If no intact two step unit is attacking, all-out attacks are impossible. A die is then rolled, and the score is cross-referenced with the appropriate column on the combat results table to yield the combat result. The number before the slash shows the defender's losses in a normal attack, while the number after the slash shows the defender's losses in an all-out attack. Attacks on hexes containing more than four units (not counting any retreated units) always inflict losses at the all-out rate, with no need for the attackers to take a loss.

The standard way to absorb losses is to lose as many steps from defending units as the loss result. The defenders choose which units absorb losses, except that no unit may be completely eliminated while there are any intact two step units to flip to their weaker side. All unretreated defending units, not just those that contributed their combat strength, are eligible to absorb losses. If more losses are suffered than there are defending steps to absorb them, all the defenders are automatically eliminated and the excess loss is disregarded.

Except in the case of automatic elimination, the defenders may be able to absorb their final loss of that combat not by losing a step but by retreating all their remaining units to one or more adjacent hexes of the defenders' choice. Retreating is voluntary, except that Soviet forces that suffer two or three losses must retreat to absorb the final loss if they are able to do so. If possible, units must retreat into hexes not adjacent to enemy units. If this is not possible, units may retreat into hexes next to the enemy that contain other friendly units. Units may never retreat off the board, or into vacant hexes that are next to an enemy unit or are enemy supply source hexes. Units in a friendly supply source hex may only retreat into another friendly supply source hex, and not even there if the hex is vacant and next to an enemy unit.

All units that retreat have a retreat marker placed on them, which remains there until it is removed at the end of their own next

player turn. Retreated units may neither attack nor move during their own player turn. If the hex to which they retreat is attacked later in the same attack phase, they do not count at all in the defence, may not absorb losses, and are automatically eliminated if all the normal defending units retreat or are eliminated.

MOVEMENT

During the friendly movement phase, each unretreated friendly unit may be moved one hex if desired, to any adjacent hex that does not contain an enemy unit. There is no limit on how many friendly units may occupy a single hex. If the ground is not yet muddy, then supplied tank, panzer, mechanised and cavalry units may instead move two hexes in succession, in any direction or combination of directions as long as they do not enter an enemy occupied hex. Cavalry may make such two hex moves regardless of terrain, but tank, panzer or mechanised units may not enter two woods hexes or cross two river hexsides (although they may do one of each). Units may never move off the board or enter a hex containing enemy units.

SPECIAL RULES

On *turn one*, all Soviet units may attack, but only the three tank units may move, and they must end the movement phase in different hexes from one another. German units on turn one may retreat only into hexes that contain friendly supply sources or other German units, and only then if the hexes are eligible for retreats and have suffered no losses in earlier Soviet attacks. In the first German player turn, only the four panzer units may attack, and only one of them (and no other German units) may move.

On *turn two*, Soviet supply lines may not be traced more than three hexes to a supply source hex, and German units may not move or retreat into Tichonovka because of the small Soviet pocket hanging on there from an earlier attack. On turns two and three, no German units that start their movement phase in or adjacent to Korsun may move unless a Soviet unit has ever entered a hex adjacent to Korsun.

Units on both sides suffer a maximum of one adverse column shift for being unsupplied on turns one and two, whether they are attacking or defending. The same applies to German units defending in or attacking out of Korsun, Yanovka or Shenderovka on later turns (even in combination with attacks from other hexes), as long as Korsun (with its vital airfield and supply dump) contains a German unit at the moment when the attack takes place.

Each turn *from turn three onwards* begins with a die roll to determine whether the ground thaws and turns to mud. As soon as a die roll of 1 or 2 occurs, the turn marker is flipped to its mud side, and mud conditions continue for the rest of the game. Mud limits all movement to one hex, and produces an adverse column shift in attacks.

At the end of the *Soviet* supply and reinforcement phases on turns five and seven (which are marked by red stars as a reminder), one reduced strength corps anywhere on the map may be flipped back to full two step strength, as long as it is in supply. The unit may then attack and move normally, unless it is retreated.

On *turn eight*, unsupplied units on either side that are not retreated and do not move during their movement phase may attempt to break out to friendly lines at the end of the phase, as

long as there is at least one hex within a two hex radius containing a supplied friendly unit. Each evacuating unit rolls a die, and adds one to the score for every such refuge hex it has available (so the modifier will be at least +1). If the modified roll is 5 or more, the unit is removed from the map but is considered to have survived at its current step strength. If not, the unit is removed and is considered to have been eliminated.

VICTORY

After eight turns, play ends and victory is assessed. First, both sides (starting with the Soviets) eliminate all friendly units that cannot trace a supply line at that instant. Then, each side scores one victory point for each step of enemy units in the destroyed box, one victory point for each enemy two step unit still on the map but with only one step remaining, and two victory points for each enemy supply source hex currently occupied by a friendly unit. The Germans add ten points to their score as a handicap bonus. The side with more points wins a game victory, and the bigger the margin, the more decisive is the triumph.

INITIAL SETUP

Units are initially deployed at full strength in the hexes shown in Figure 10.3 and the following list. The first letter of the unit codes stands for infantry, mechanised, cavalry, tank or panzer, while the second letter stands for brigade, division or corps. The turn marker is placed with its ‘snow’ side up in the first box of the turn record track:

German deployment: Novaya Greblya: 34 ID; Vinograd: 198 ID; Medvin: 88a IB; Boguslav: 88b IB; Alexandrovka: 332 IB; Maslovka: 255 IB; Kanev: 112 IB; Korsun: Fouquet IB; Moshny: Walloon MB; Starostelye: 5SS MD; Orlovets: 57 ID; Smela: 72 ID, 5SS PB; Kapitanovka: 389 ID; Panchevo: 3 PD, 106 ID.
Soviet deployment: Tinovka: 5G TC, 47 IC, 104 IC; Koshevatoye: 180 ID, 337 ID; Tarashcha: 159FR ID; Bukrin: 206 ID; Orshanets: 254 ID; Dubiyevka: 294 ID; Syabotin: 373 ID; Kamenka: 20G IC, 21G IC, 26G IC; Shpakovo: 20 TC, 29 TC, 48 IC, 75 IC.

REINFORCEMENTS

After supply has been judged for friendly units already on the map, any reinforcing friendly units due to arrive that turn are placed in their entry hexes at full strength. If the designated arrival hex is enemy occupied, they arrive instead in the nearest vacant or friendly occupied friendly supply source hex (owner's choice if two such hexes are equidistant). Reinforcements may not be delayed, and may attack and move normally that turn. The 24th Panzer Division arrives on turn four only if a Soviet unit has ever entered a German supply source hex not adjacent to a Soviet supply source hex – otherwise, the division is sent back to the crisis at Nikopol and never appears in the game. Reinforcing units should be placed on the turn record track as shown in Figure 10.3, and appear according to the following schedule:

Turn one: Panchevo: 14 PD, 11 PD.
Turn two: Kamenka: 5G CC; Shpakovo: 18 TC, 49 IC; Panchevo: 320 ID.
Turn three: Mokraya Kaligorka: 13 PD; Panchevo: 376 ID.
Turn four: Tinovka: 5 MC; Tarashcha: 54FR ID; Novaya Greblya: 16 PD, 17 PD; Yekaterinpol: (24 PD).
Turn five: Tinovka: 3 TC, 16 TC; Novaya Greblya: 1SS PD.
Turn six: Yekaterinpol: Haack IB; Ryshanovka: 1 PD.

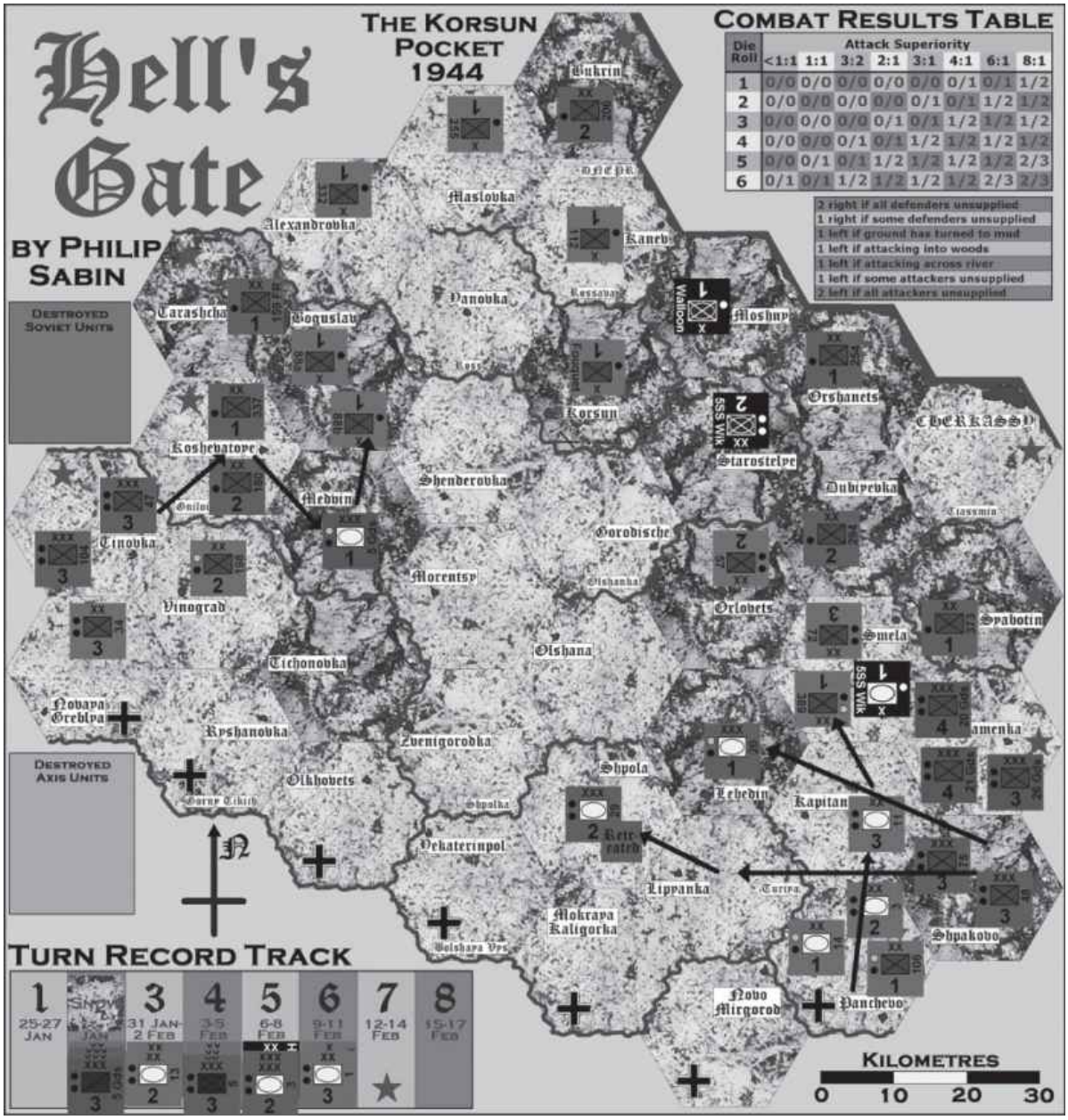
EXAMPLE OF PLAY

Since dicing for a thaw does not commence until turn three, the first activity on turn one is checking Soviet supply. Most Soviet units start off actually occupying supply source hexes, and the 254th and 294th Rifle Divisions may trace supply either to friendly occupied Syabotin or to the vacant Cherkassy hex since it is not next to a German unit. With no Soviet reinforcements due until next turn, play moves swiftly on to the Soviet attack phase. As happened historically, the Soviets decide to attack first with the Second Ukrainian Front. The main effort will be against the 389th Infantry Division in Kapitanovka, but before that, the Soviets decide to attack Panchevo to inflict some attrition and to prevent the 389th retreating out of the encirclement.

The two German units in Panchevo have a combined defence strength of four. The 75th and 48th Rifle Corps with a combined strength of six could attack them at odds of 3:2, but the Soviets decide to use the 29th Tank Corps instead of the 75th Rifle Corps. Since its basic combat strength of two is trebled when attacking into clear terrain, this gives them a combined attack strength of nine, enough to achieve 2:1 odds since no column shifts apply. The Soviets could greatly increase their chances of success by declaring an all-out attack, but this would require them to sacrifice a precious step from their tank unit, so they opt for a normal attack instead. On a die roll of 5, they get lucky and inflict a hit on the Germans. The defenders could choose to retreat across the river into Novo Mirgorod (the only permissible direction since they already occupy a supply source hex), but this would mean giving up the valuable position in Panchevo itself, so they opt instead to hold on and take a step loss. Both defending units are at two step strength, so the obvious choice is to flip the 106th Infantry Division to its reduced strength side while keeping the 3rd Panzer Division intact.

Konev now launches his main effort against Kapitanovka. The 75th Rifle Corps and 20th Tank Corps contribute nine points in the clear terrain, and the 21st and 26th Guards Rifle Corps in Kamenka add another seven points, just reaching the sixteen points needed to make a maximum attack at 8:1 odds, again with no column shifts in effect. The Soviets could limit themselves to

another normal attack, but this leaves a two-thirds chance of the 389th holding on with a step loss and foiling the breakthrough, so they instead play safe and flip the 20th Tank Corps in an all-out attack. On a die roll of 3, the defenders suffer two hits. The first hit must be taken as a step loss, and absorbing the second hit in this way would destroy the division altogether, so the only sensible option is to retreat. The unit would normally have to pull back to Lipyanka or Lebedin (since these hexes are not adjacent to the enemy), but the special turn one constraints mean that only German supply source hexes or those already containing a German unit are permissible destinations. Panchevo is ruled out on turn one because the units there have suffered a hit of their own, so there is no option but to withdraw the 389th north to Smela, after which a retreat marker is placed on the unit.



10.4 *Hell's Gate* example

To try to widen the breach further, the Soviets now turn against the Smela salient itself. However, only the 20th Guards Rifle Corps remains in Kamenka to conduct the attack, supported by the 373rd and 294th Rifle Divisions to the north. Their combined strength of seven is not quite enough to achieve 2:1 odds against the four points of defenders (the retreated 389th being ignored), but at least the column shift for the Tiassmin River does not apply, since fewer than half of the attacking units are affected by the obstacle. An all-out attack at 3:2 odds would have a good chance of either hitting the 72nd Infantry Division or forcing a retreat to Orlovets and so

destroying the remnants of the 389th altogether, but this would mean eviscerating the strong 20th Guards unit in the process, so the Soviets settle for the long shot of a normal attack instead. On a roll of 4, the attack has no effect.

In the north, the 206th Rifle Division could attack the screening forces of Korps Abteilung B at 2:1 odds, but it could not safely advance even if it pushed one of the German units back because its own supply line to Bukrin would then be interdicted by the other unit, so it bides its time for the present. The focus hence moves to Vatutin's second prong of the overall pincer movement. His main force at Tinovka could focus its efforts either on the 34th or 198th Infantry Division. The former unit occupies a valuable supply source hex, but it could retreat without opening a gap in the German line, so the Soviets attack the 198th in Vinograd instead. Only two units can attack across the single hexside, yielding 3:1 odds thanks to the trebling of the 5th Guards Tank Corps' basic strength. Adding in the two divisions in Koshevatoye would push the odds to 4:1, but would bring no net benefit because the cross-river combat penalty would be triggered. Hence, the Soviets launch an all-out attack instead, and flip the 5th Guards to their reduced side. A die roll of 2 inflicts only one hit on the 198th. It could remain intact and retreat to Ryshanovka (a supply source hex not adjacent to a Soviet unit), but the Germans decide instead to take a step loss and keep the line intact.

Vatutin's only hope for a breakthrough now comes from the secondary attack by the 27th Army. All three divisions could focus on the northern half of the 88th Infantry Division in Boguslav, but a better axis for the encirclement runs through Medvin further south, so the 180th and 337th Rifle Divisions attack there instead. The basic combat odds are 3:1, but the leftward shift because of the woods cuts this to 2:1, and only a normal attack is possible because the Soviet units both have single steps. However, on a die roll of 5, the attackers get lucky and inflict a hit. The weak defenders have no choice but to retreat, and with Vinograd barred to them because it has suffered a hit itself, the only option this turn is to unite with the rest of the 88th in Boguslav.

Play now proceeds to the Soviet movement phase. On turn one, only the three tank units are allowed to move. As shown in Figure 10.4, Vatutin redirects his depleted 5th Guards Tank Corps

through Koshevatoye and into Medvin, exploiting to the maximum the tanks' capacity to cross one river and enter one woods hex. In the east, Konev's two tank corps must move to different hexes, and the Soviets decide to send the depleted 20th Tank Corps two hexes to the woods around Lebedin and the stronger 29th Tank Corps to Lipyanka. Kapitanovka is left vacant, because even if garrisoned it would be likely to fall to a panzer counterattack. This ends the Soviet player turn.

In the German supply and reinforcement phase, the bad news dawns that the twin Soviet pincers have already cut the supply lines to all the units north of Vinograd and Panchevo, since both German frontlines have been breached and there are no vacant hexes for supply passage which are not adjacent to the Soviet spearheads at Lebedin or Medvin. Hence, all German units in the north are rotated through 180° to show that they are unsupplied, although their existing stockpiles mean that they will not suffer the full penalties until turn three. The 11th and 14th Panzer Divisions now arrive as reinforcements in Panchevo to join the two divisions already there.

In the German attack phase, the turn one restrictions mean that only the four panzer units may attack. The 5th SS panzer battalion is too weak to hurt the 20th Tank Corps because the woods and the lack of supply restrict its capabilities to a pointless normal attack at 1:1 odds. However, in the south it is a very different matter. The maximum attack force of the two newly arriving panzer divisions has its strength trebled to fifteen against the 29th Tank Corps in Lipyanka. Unfortunately, this is not quite enough to achieve 8:1 odds, and the penalty for attacking across the Turiya River cuts the final odds to just 4:1. The Germans decide to make an all-out attack by flipping the weaker 14th Panzer Division to its reduced side, but on a roll of 2, they still only inflict one hit on the enemy. The 29th could hold in place and lose a step itself, but it decides instead to remain intact and 'retreat forwards' to Shpola, which is not adjacent to a German unit. The main penalty it suffers is that it gains a retreat marker, which will constrain its actions next turn.

The 3rd Panzer Division has no chance on its own against the strongly held woods around Shpakovo, so play proceeds to the German movement phase. Only one panzer unit is allowed to

move on turn one, and the obvious candidate is the strong 11th Panzer Division. It could enter Lipyanka to follow up the 29th Tank Corps, or even move on from there to Mokraya Kaligorka (so avoiding the river hexsides on the route via Novo Mirgorod), but it decides instead to take a risk and reoccupy Kapitanovka, thereby re-establishing a direct link with the pocketed forces (as happened historically for a brief time). The retreat markers on the 88th and 389th are now removed, and turn one is complete. Next turn, the 20th and 29th Tank Corps will be unsupplied because of the limitation of their supply lines to three hexes, despite their being able to trace a longer supply line via Vatutin's forces in Medvin. The key question is whether the Germans will be able to keep hold of Kapitanovka in the face of an all-out assault by Konev's arriving second echelon forces. There is only a 1 in 6 chance of their being able to resist the likely 6:1 all-out attack, and even if they do, the continuing movement restrictions around Korsun make a prompt evacuation of the pocketed forces problematic. With four German and two Soviet steps having been lost so far, the Germans face a hard struggle to recover from the continuing onslaught and to rescue their trapped men.

11

Tactical combat

All four of the simulations I presented in Chapters 9 and 10 model specific battles or campaigns at the operational or strategic level. Although most published board wargames focus similarly on recreating individual battles or campaigns, a significant minority instead provide more generic tactical systems that allow the simulation of an unlimited number of real or hypothetical engagements at a much smaller scale. In professional military wargaming, such generic tactical simulations have always played a very important role, since the focus is on preparing forces for possible future engagements rather than studying individual past conflicts for their own sake. Ever since the days of *Kriegsspiel*, generic tactical modelling of contemporary combat dynamics has been a major preoccupation of military wargamers.[1] Hobbyists, too, have felt the urge to explore small-scale combat dynamics, not just of modern warfare but also across a variety of historical eras. They have based their models not on a single specific battle but on evidence from a wide range of different engagements in the period concerned, thereby utilising to the full the 'comparative' element of the research methodology outlined in Chapter 4. This has allowed hobbyists to create simulations that zoom in to the smallest scale of tactical interactions, with counters often representing individual ships, aircraft, vehicles, or even soldiers.[2] As I mentioned in the Introduction, wargames using miniature figures on sculpted terrain rather than counters on a map are especially focused on such tactical clashes, since the physical models give a very evocative visual feel for contests at this level.[3]

I discussed in Chapters 1 to 3 how computer games have increasingly displaced boardgames as the vehicle of choice for simulating warfare, both in the popular mass market and in professional military wargaming. This is especially true in the field

of tactical simulations. Whereas even miniature figures can only portray static ‘tableaux’ of a developing battle, real-time computer simulations can make engagements ‘come to life’ by opening an increasingly vivid 3D window into a cinematic visual and aural representation of real battlefields. The computer can handle the complex physical calculations associated with close-quarter combat, so that players may view the world through the eyes of their own personal ‘avatar’, whom they guide using a simple set of control inputs to mirror real head, hand and leg movements. Networked systems now allow multiple avatars to cooperate and compete in a common virtual world, thereby reducing the need for non-player entities to be controlled by often unrealistic AI routines. Given the incredible capabilities of modern computer games, it is hardly surprising that tactical board wargames have now been so completely overshadowed, with each game selling only a few thousand copies worldwide whereas the most successful video combat games such as the *Call of Duty* series achieve sales in the tens of millions.[4]

Nothing could better illustrate the contrast in technical capabilities than tactical simulations of air warfare. There are quite a few board wargames on this topic, covering everything from the wire and canvas dogfights of World War One and the varied clashes of World War Two to the jet duels in Korea, Vietnam and the Arab–Israeli wars and the latest high-technology aerial contests. Early boardgames on these various eras were little more complex than standard wargames of the time, but they were very unrealistic in their representation of the complex 3D physics involved. For example, hard turns often slashed the immediate distance covered by aircraft but had no impact on their final speed, whereas the real impact of turning should be precisely the opposite.[5] Later boardgames managed a somewhat more realistic representation of the physics of flight, but at the cost of burgeoning complexity and a consequent growth in playing time.[6] This process reached absurd extremes in David Isby’s ultra-complex 1977 simulation *Air War* and in the various more recent games by J.D.Webster, which include several dozen pages of rules and charts, and in which each round (representing just a few seconds of action) can take tens of minutes to resolve.[7] There

have been a few attempts to return to earlier simplicities, and the 1980 game *Ace of Aces* had the novel idea of doing away with map and counters altogether and instead giving each player a book showing over 200 different possible views from their own cockpit to the enemy plane, but when computer games came along that could show such first person views in real time while also handling multiple aircraft and giving a much more realistic simulation of flight dynamics, it is not surprising that old-style manual systems were soon eclipsed.[8]

In my third year BA course on Fighting in the Air, I set up a data projector and use several different commercial PC flight combat games at intervals throughout the course to give the students some first-person perspectives to supplement other sources such as aircrew testimony. The beauty of this technique is that the real-time nature of the simulations means that they take up only tens of minutes of each class, and that I can usually let one or more students handle the joystick, thereby increasing their sense of involvement and freeing myself from trying to talk and 'fly' at the same time. As I discussed in Chapter 2, two major offsetting limitations of computer games from an educational perspective are that they are often difficult to run as hardware and software requirements evolve, and that it is very hard for non-programmers to modify the games to correct misleading content and to tailor the simulation to focus on the specific educational objectives required. These two problems interact rather perniciously, since one usually has to wait a while after a game is released to be able to run it smoothly and to incorporate 'mods' developed by historically minded enthusiasts to make the simulation more realistic, but not long after that, it usually becomes difficult or impossible to run the game at all as operating systems and hardware drivers evolve and introduce incompatibilities with the original software. I used to use heavily modified versions of the 1998 PC games *Red Baron 3D* and *European Air War* to illustrate the dynamics of World War One dogfights and massed World War Two aerial duels respectively, but in recent years I have not been able to keep them running even though they are only ten years old.[9]

Despite these problems, I do currently use several more recent computer games in class to convey a variety of tactical insights about air fighting over the past century.[10] *First Eagles* allows me to explain basic fighter manoeuvres in the context of World War One, and to show how well-handled scouts could attack two seaters from the blind spot beneath their tail.[11] *Battle of Britain II* lets students experience something of the massed air combats of 15 September 1940 from the contrasting perspectives of a British and German fighter pilot and a German bomber gunner, and it conveys wonderfully the problem of distinguishing friend from foe in these tangled and fast moving engagements.[12] The simulation also shows vividly how hard it was for British pilots to keep a lookout while flying in closely spaced 'vics' compared to the looser and more line abreast arrangements of the German fighting pairs.[13] I use a modified version of *Strike Fighters* to give students a feel for the very different challenge faced by German night fighter crews searching for targets within a British bomber stream in 1943–44, and I employ *IL2* to let students see the difficulties that inexperienced German pilots had in finding and strafing Allied airfields during Operation Bodenplatte on New Year's Day in 1945.[14] Finally, I use the obsessively detailed and complex *Falcon 4.0* to give students a flavour of the multiple computer displays within a modern F-16 cockpit (it is difficult to do more, since the game manual is 716 pages long!).[15]

Computer simulations cannot be beaten when trying to convey such real-time first-person perspectives, even though they do have serious limitations as I discussed in Chapter 2. However technically accurate an individual simulation may be, nothing can convey the terror that real mortal peril engenders. My students blithely fly their simulated craft into a hail of enemy fire, and over half their 'sorties' end with their own aircraft being shot down – an absurdly high casualty rate caused not by inaccurate weapons modelling but by the unrealistic bravado of the contending aircrew (whether human or AI controlled).[16] Only by stepping back from the first- person perspective is it possible to model the self-preservation instinct more effectively, by removing the simulated combatants from direct player control and programming them with a healthy dose of automatic caution and fear, thereby bringing

loss rates down to a more realistic level. Once one moves away from a real-time first-person perspective and instead tries to take a more detached overview of the process of combat, computer simulations lose much of their inherent advantage, and simpler top down manual modelling based on observed outputs rather than theoretical inputs becomes a viable alternative. Hence, although ultra-tactical perspectives from the viewpoint of the combatants themselves are now far better conveyed by computer games than by manual ones, grand tactical overviews of an entire battle can still be created effectively by either technique.

I described in Chapter 9 how my previous book, *Lost Battles*, uses manual simulation techniques to construct a generic grand tactical model of ancient land combat, which can be used to reconstruct and provide comparative insights into several dozen individual engagements from the period.[17] Although computer games do exist that model ancient battles from a similar grand tactical perspective, they tend either to be low-budget niche products that mirror existing boardgame techniques of hexagons and turn-based action or (as with *Rome: Total War*) 3D extravaganzas shaped as much by mass market commercial imperatives as by a drive for realistic simulation.[18] In this chapter, I provide three further examples of how boardgame techniques may be used to provide academic insights into generic tactical or grand tactical contests, all set within my other specialist period of World War Two. First, I will outline a simple simulation of a British infantry battalion attack in 1943–45, focusing on the employment of *Fire and Movement* tactics to exploit and overcome the terrifying suppressive effects of modern firepower. Then I will introduce *Block Busting*, a smaller scale variant of the same system, which focuses on the special challenges of combat in urban areas. Finally, I will present *Angels One Five*, a manual simulation of air warfare that I have used for several years to complement first-person computer games and to give my third year BA students a clearer overall understanding of angles and energy tactics and of the grand tactical dilemmas of intercepting and escorting massed bomber formations.

My BA course on World War Two (unlike my other courses on fighting in the air and on warfare in the ancient world) covers only

the strategic and operational and not the tactical dynamics of the contests concerned. Hence, the division-level model *Hell's Gate*, which I outlined in Chapter 10, is the lowest tier of the 'nested set' of simulations used in that course. However, there are many classes around the world that are more focused on teaching cadets, soldiers or officers basic tactical and leadership skills, and which could benefit from a more grand tactical simulation. As I mentioned in Chapter 3, the current 'state of the art' in virtual military instruction at the tactical level is a networked computer suite in which each participant has her own terminal and controls her own personal avatar in real time using software such as *VBS2* (based on the commercial PC game *Armed Assault*).[19] This approach is very costly and makes it hard to model properly the suppressive effect of fire, so it could usefully be complemented by a deliberately 'cheap and cheerful' manual model at a grand tactical level in which each participant still has her own personal command (in this case a platoon or company rather than a single individual), and in which the simulation is simple enough to run roughly in real time by taking only an hour or two to complete. If I provide a couple of illustrations based on generic historical scenarios, this should help you to design your own variants for whatever period, command level and situation suits your own particular interests or training and educational needs.

There are many board- and figure games of World War Two land combat in which the counters represent sections or platoons. Some are focused on tank warfare, but others (in particular the long-running series that started with John Hill's 1980 game *Squad Leader*) concentrate on infantry as the primary combat arm.[20] Computer games at this level include John Tiller's hex-based *Campaign Series*, and the innovative *Combat Mission* series, which blends turn-based orders and real-time calculation of combat.[21] *Combat Mission* captures well the suppressive effects of fire, and there are now several lower level computer simulations that track individual soldiers and in which the primary effect of fire on the AI-controlled combatants is to pin them down rather than kill them, thereby encouraging a 'fire and manoeuvre' approach.[22] The trouble with using these published simulations to model an attack by an entire battalion is that they are too complex and finely

detailed for such a contest to be playable in class – *Advanced Squad Leader* (despite its relatively large number of devotees) is possibly the most complicated manual wargame ever produced.[23] Modern tactical land combat is certainly a very complex phenomenon, given the degree of dispersion, the variety of weapons, the tangled impact of terrain, and the dominant influence of individual human initiative and frailty, but my aim is to reject the fetish for detailed simulation and to create a radically simpler model by focusing only on the most significant overall aspects of the contest.

Not many sources focus on the mechanics of World War Two infantry combat at the company level, since this subject tends to fall in between the flood of individual memoirs that have appeared in recent years and the broader historical accounts of entire battles and campaigns.[24] Some memoirs by junior officers like Sydney Jary, Peter White, Edward Grace, Philip Brutton, George Wilson and Charles MacDonald do convey something of the overview required, and some accounts of individual engagements such as Operation Epsom, the attack on Hill 112, the assault on Geilenkirchen and the defence of Bastogne contain significant levels of grand tactical detail.[25] There are also a few valuable histories of individual British battalions across the latter half of the war (based on sources including the battalion war diaries), and Kenneth Macksey has written an interesting fictionalised account of an attack by such a battalion in the Normandy *bocage*.[26] However, the most valuable sources for this simulation are wartime tactical manuals on infantry battle drills, along with the very useful recent analyses by Stephen Bull of different nations' such manuals.[27] The British and German manuals in particular stress the importance of using covering terrain and achieving fire superiority in order to allow part of the force to advance. One British manual warns that: 'If the enemy is dug in, covering fire seldom kills him; it merely makes him keep his head down so that he is unable to shoot back.' The same manual advises that: 'In order to allow covering fire to continue right up to the moment the assault goes in, every effort must be made to assault from a position off to one or other of the flanks.'[28] It is this interdependence of fire and movement that will be the central

dynamic of the simulation, as encapsulated in the following description by a Guards officer of an attack at Anzio:[29]

> Our company was ordered to attack Carroceto village. My platoon was to give covering fire while the assault was to be made by the platoon commanded by a chap called Needham. We blazed off with all weapons at the village. Needham led the way over an embankment, over a wire fence and across open ground to the nearest buildings. We had to stop firing then, of course, as Needham and his men charged into the first house. To our amazement, about six terrified Italians ran out, their hands up, shouting 'Amico! Amico!' But then a machine gun opened up from a nearby building. Needham dived for cover and ordered one section to fire while he with the other two sections attacked from one side. Great chap Needham! A grenade settled the machine gun. They soon captured all the other houses.

The standard British rifle battalion in World War Two contained four rifle companies, each with three platoons of up to three dozen soldiers. It also had a larger headquarters company, with various supporting platoons including one with six three inch mortars.[30] The simplest way of modelling the battalion is to have one counter for each of the twelve rifle platoons, plus one for the mortar platoon off the board to the rear. Attacks would usually be supported by divisional artillery and by attached tank platoons, but this would add significantly to the complexity of the system, so I limit the role of the artillery to an initial preparatory bombardment and to assumed counterbattery fire against German guns, and I restrict attached assets to one platoon of Vickers machine guns to provide additional covering fire.[31] In line with the common rule of thumb that attackers need roughly 3:1 superiority to succeed, I give the German defenders two companies each of three depleted platoons.[32] This depletion neatly offsets any asymmetries in fighting value due to the oft remarked on German advantages in tactical performance and in weaponry such as the MG 42, and it allows me to treat the British and German rifle platoons as equally effective for game purposes, with the very significant exception

that the latter benefit from being dug in on the defence while the British must shoulder the burden of attack.[33] To reflect command inflexibilities, platoons from different companies cannot stack together or combine their fire against the same target.

Battalion attacks in World War Two generally took place on a frontage of a kilometre or less.[34] The advance from the start line to the enemy main line of resistance usually covered at least a similar distance, but to save time, I focus on only the last 500 metres or so. Hence, I use a battle area around 1200 metres wide and 700 metres deep. As I discussed in Chapter 5, carving such an area out of a much larger overall battlefield introduces inevitable artificialities, especially regarding the influence of unmodelled forces on either flank, but this size of battle area does allow the attackers to focus their efforts on one selected part of the defending line without giving them unrealistic freedom to conduct an 'end run' around either wing. I divide up the board using a six by eight hex grid, with each hex representing an area some 150 metres across. Adapting deployments and manoeuvres to fit the specific terrain was a crucial tactical skill, so I use a simple system to generate different random terrain layouts for each contest – most hexes contain undifferentiated farmland, but there is a one in six chance that each hex may instead contain a low ridge, a wood or a farm (as determined by a further die roll). This creates an endless variety of grand tactical landscapes without getting bogged down worrying about every hedge and ditch. I let the Germans choose which half of the resulting board to defend, to reflect their broader flexibility in positioning their defence line.

The game is played in turns representing five to ten minutes each, allowing troops to move one hex per turn (a scale speed of up to one mile per hour, which is perfectly adequate for cross-country moves in the face of the enemy, especially when one factors in command delays). Limiting moves to one hex means that there is no need for 'opportunity fire' mechanisms to catch troops who become exposed halfway through a longer move. Units in reserve off the map may redeploy laterally at a much faster rate, hence encouraging both sides to keep a reserve if they can spare the men to do so. Instead of moving, platoons may

remain stationary and fire at a given enemy hex. (In reality, part of a platoon could move while the rest provided covering fire, but this is simplified in the game to a division of labour between platoons as a whole.) Fire can pin down all units in the target hex, preventing their moving or firing in their own upcoming player turn. The chance of ordinary platoons pinning down enemies in this way declines with distance, but mortar and machine gun platoons have undiminished suppressive effects at any range. Each unentrenched platoon suffers one casualty point whenever it is pinned down by long-range fire, and one platoon is broken and removed from play for every six casualty points sustained by the force as a whole. The removal of a unit represents a few key troops becoming casualties and the rest becoming too demoralised to fight on effectively. I model close combat by trebling the chance of platoons being hit by assaults from adjacent hexes, and by making even entrenched units vulnerable to such assaults – the British hence need to pin the Germans down for long enough to allow one or more British platoons to move adjacent and launch a close assault to winkle them out. Placing movement before firing means that attackers must commit themselves to an advance before they know whether covering fire will be effective, while alternating player turns between the two sides ensures that the defenders will always get to fire first when their enemies move into view – the British must exploit their numbers to recover from this disadvantage and turn the tables on the Germans once a firefight develops.[35]

One key aspect of the simulation is its treatment of force density. If platoons simply engaged individual enemy platoons on a one against one basis, the game would be wide open to the Lanchestrian distortions and excessive privileging of numerical superiority discussed in Chapter 1. Hence, it is vital to reflect the protective impact of dispersion that Lanchester's square law failed to take adequately into account. I do this by having each firing platoon target a pair of adjacent hexes rather than individual units, with successful fire pinning down and causing casualties to every unit in the two hexes. Since the two hexes between them may contain anything from a single platoon to two entire companies, this neatly reflects the crucial trade-off between concentration and

dispersion – concentrated forces can squeeze more firepower into a given sector of front, but they are much more vulnerable themselves to being pinned down and suffering casualties than if they spread out across a wider area.[36] Even though the German defenders have only six platoons to cover an eight hex front, this encourages them to keep one or two platoons in reserve instead of cramming them all into the main defence line.[37] The British must bunch up more in order to win fire superiority while also pressing the advance, but they must beware of exposing themselves to unsustainable casualties, especially since the Germans are given limited access to mortar support of their own to use against vulnerable concentrations of attackers.

The main impact of terrain features is to block lines of fire and so create dead ground. Most tactical boardgames have complex line of sight rules that involve physically tracing a path between the centres of the hexes concerned, but my own use of large hexes allows the problem to be resolved using just three generic diagrams, since potential obstructions will always be within two hexes of either firer or target.[38] The secondary effect of terrain is to protect against incoming fire by providing cover and concealment, although mortars are unaffected because of their high trajectory and the possibility of treebursts. The Germans hence face an interesting dilemma of whether to deploy in covered terrain with extensive fields of fire or in dead ground further back where they are immune to long-range British fire and so can remain unsuppressed and ready to ambush targets that appear at close range or on the flank. Ridges are a double-edged sword for the Germans, since they provide the most common type of defensive cover but also expose troops atop them to overhead covering fire, especially from the dreaded Vickers guns. However, since the Germans have to defend their entire front to stop the British penetrating through the line, they cannot simply hunker down in the most defensible locations, and some unthreatened platoons will probably need to leave the protection of their foxholes and redeploy to counter the main British thrust. This produces interesting possibilities for the British to use reserves to switch their direction of attack and catch the enemy off balance, albeit at the cost of precious time. The more tangled the terrain,

the harder it often is for the German positions to support one another, and hence the greater the risk that they can be defeated in detail. The initial deployment of the German platoons (including the identification of possible contingency positions for reserve platoons) is thus one of the most decisive elements in the game.

One neglected aspect of infantry combat is that troops moving on foot could only physically carry enough ammunition for around five minutes of continuous firing.[39] This helps to explain the effectiveness of the German practice of prompt counterattacks to regain lost positions, since the victorious attackers must have been chronically short of ammunition before they could be resupplied.[40] It would obviously be ridiculous to allow each platoon to fire for only a single five- to ten-minute turn, since fire rates must have been far lower in practice so as to conserve ammunition during extended engagements. However, I do rule that every sixth fire attack causes the firing unit itself to run short of ammunition and be removed from play as if it had withdrawn into reserve. This presents British players with the difficult dilemma of whether to deliver heavy covering fire at the cost of early ammunition depletion or more sporadic fire at the risk of leaving the defenders insufficiently suppressed. A major advantage for the Germans is that they are not subject to ammunition depletion, since they are assumed to have stockpiled large numbers of machine gun rounds for their more static role. After twelve turns (representing up to two hours of fighting), the exhausted antagonists are assumed to hold their current positions and await reinforcements and resupply, and victory is determined based on the two side's casualties, how many German units remain on the map, and how many British units have managed to penetrate the enemy line and occupy the German board edge. (The British are rewarded for reaching the enemy board edge even if this leaves isolated German forces still in position on the field, since a key feature of the 'infiltration tactics' pioneered by the Germans themselves in 1917–18 was to bypass pockets of resistance and leave them for follow-up waves to reduce.)[41]

One noteworthy element of the game system is the way in which random variation is managed so as to privilege skill rather than luck, as illustrated in Figure 8.1 and explained in Appendix 3.

This is important given the suspicion of die rolling among military users in particular. Each firing unit dices separately for the two hexes it engages, to allow luck to even out over a larger number of die rolls. Instead of there being a one in six chance that each hit will cause enough casualties to break the target unit, overall casualty points are accumulated and a unit is removed for every six points inflicted, thereby reducing the effect of lucky die rolls in this crucial area. The British use a similar approach to track their overall ammunition expenditure by counting each fire attack, while the Germans have a more subtle system, which makes their mortars progressively less available the more they have been called on already. The result of all this is that the impact of sheer chance is reduced and the emphasis is transferred to player decisions, although without making the contest anything like as unrealistically certain and calculable as in a game of chess. Playtesting shows that the contest is a rather unstable one that can swing heavily in favour of either side, since if the British thrust loses momentum the attackers can be worn down without reply, whereas if the Germans lose even one platoon, they themselves can suffer an accelerating collapse (although constraints on time and ammunition make it hard for the British to break the entire defending force). I will now present the full rules, so that you may try the system and develop your own tailored variant as desired. (The two plates of components are designed to be photocopied, expanded, and printed in black ink onto coloured paper as described in Appendix 1.)

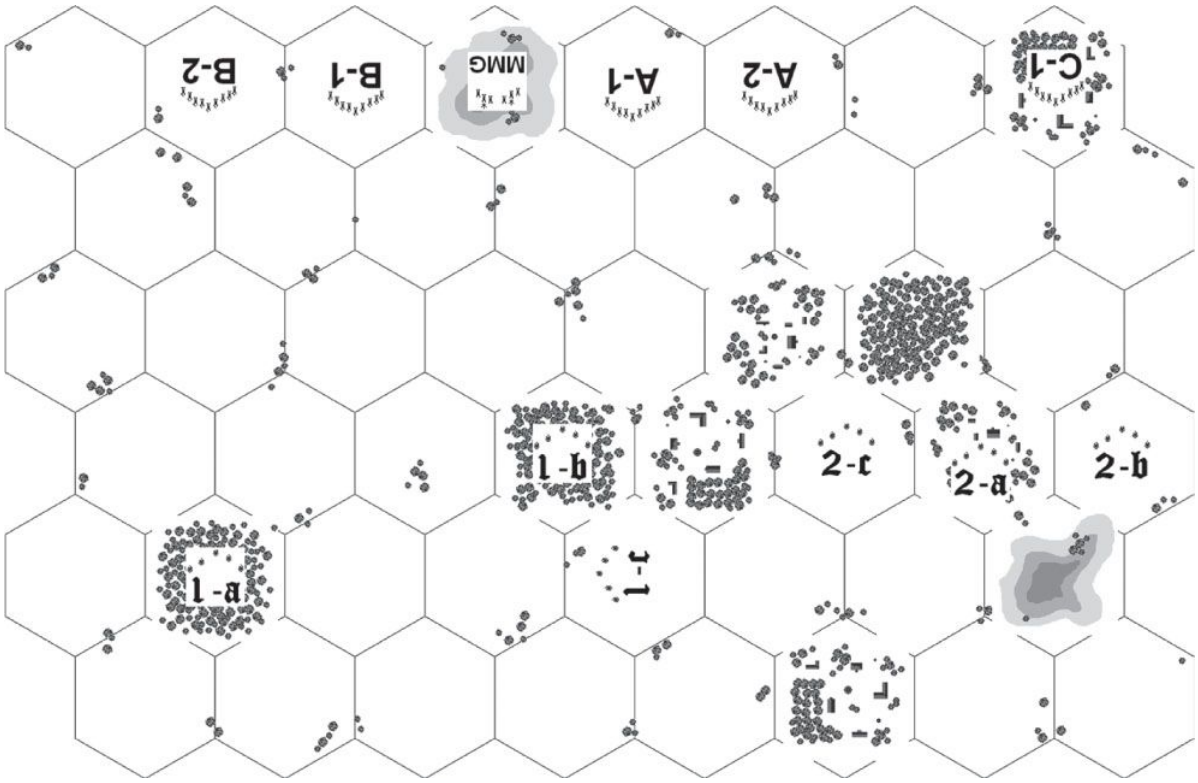
FIRE AND MOVEMENT

INTRODUCTION

This is a simple grand tactical simulation game of an attack by a British infantry battalion in 1943–45. Two players or teams direct the actions of the British and German forces as they seek to capture or defend territory and to inflict losses on the opposing forces while minimising their own losses. Team play is best with seven participants, so that one player may command each company while two overall commanders (one doubling up as a defending company commander) provide general direction and control the supporting machine gun and mortar platoons. The simulation may also be played solitaire to study the dynamics involved.

THE MAP

Action takes place on a randomly generated map of typical countryside terrain, as shown in Figure 11.1.



11.1 *Fire and Movement* map

The map is covered with a hexagon grid, and all units on the map must occupy a specific hex. Each hex represents an area 150 metres across. Most hexes contain open farmland, but some will contain other terrain features. At the start of the game, two dice (one white and one coloured) must be rolled for each of the 48 hexes on the map. If the white die roll is a 6, that hex contains a terrain feature as determined by the coloured die roll – a low ridge on a roll of 1, 2 or 3, a wood on a roll of 4 or 5, and a farm on a roll of 6. Terrain features are indicated by placing the appropriate large counters in the hexes concerned, as Figure 11.1 shows, and the Germans then decide the direction of play. The eight hexes along each of the top and bottom map edges are board edge hexes for the respective sides. Units may start off in or move back into reserve behind their own board edge, and the British get victory points for occupying German board edge hexes.

THE PLAYING PIECES

Each side has a number of units, represented by double-sided counters as shown in Figure 11.1. The British have twelve rifle platoons each containing up to three dozen soldiers, plus an attached machine gun platoon with Vickers medium machine guns. The Germans have six depleted rifle platoons. The rifle platoons on both sides are organised into companies, each containing three platoons. The British companies are lettered (A, B, C and D), with individual platoons numbered. The German companies are numbered (1 and 2), with individual platoons shown by small letters. One side of each counter shows the platoon ‘fresh’ (with dark text), while the other side shows the platoon ‘spent’ (with lighter text). Units become spent through moving, firing, or being pinned down by enemy fire. The German platoons have two duplicate counters – one shows the unit dug in, and as soon as it moves or deploys from reserve, this original counter is permanently removed and replaced with the one showing the same infantry graphics as on the British counters. Both sides also have access to off-map fire support from a mortar platoon with three inch or 81mm mortars, but these mortar platoons are represented by a shell burst marker in the British case and by a die displaying the roll needed to obtain support in the German case.

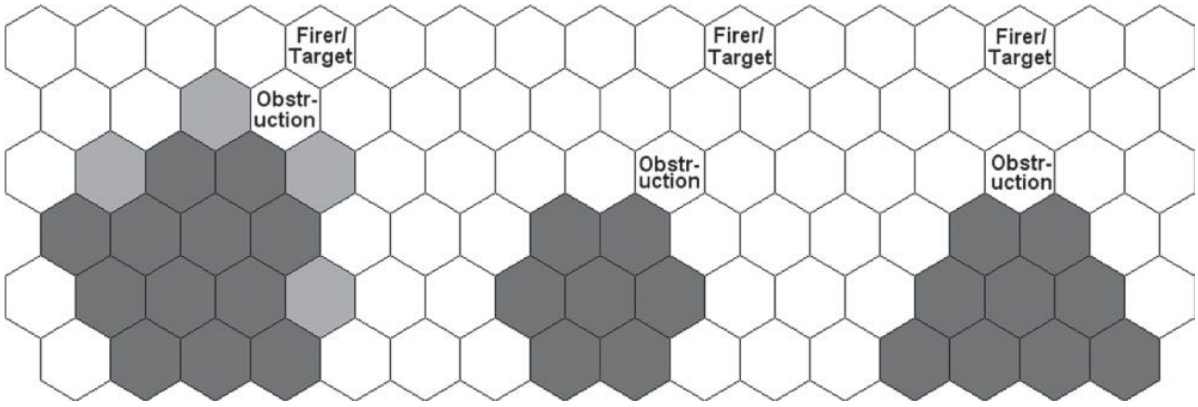
SEQUENCE OF PLAY

The game is played in turns, each representing five to ten minutes of real time. Each turn contains two player turns, with the German player turn occurring first. Each player turn proceeds through three phases:

1 movement phase
2 fire phase
3 recovery phase

MOVEMENT

In its movement phase, each fresh friendly platoon may move to an adjacent hex if desired, becoming spent in the process (and permanently losing its dug-in status if it is German). Spent platoons may never move. Units may move in any order, but they may never enter a hex containing an enemy unit or a platoon of another company. The machine gun platoon may stack with any British units, but once on the map, it may never move except to withdraw into reserve (so it can never move beyond its initial hex). Fresh platoons in any of the eight friendly board edge hexes may move off the map and into reserve, but they may never re-enter the map and must be placed to one side. Rifle or machine gun platoons that start the game in reserve may move into any of their eight board edge hexes in any friendly movement phase, subject to the normal stacking limits.



11.2 *Fire and Movement* lines of fire

FIRE ATTACKS

In its fire phase, each friendly platoon that is still fresh may fire on one or two enemy occupied hexes to which it can trace a line of fire, becoming spent in the process. Each platoon may fire either on a single hex or on two mutually adjacent hexes. Fire on a single hex (not two hexes) adjacent to the firing unit may be considered an assault if the player desires. Dug in units may conduct assaults, without losing the benefit of their entrenchments. Platoons fire individually in any order and their attacks must be resolved fully before turning to the next firing platoon, but all platoons firing on a given hex must be specified before any of them fire, and their fire may not be cancelled or supplemented, regardless of the initial results achieved. Rifle platoons from different companies may never fire on the same hex in a single fire phase, although machine gun and mortar platoons are unaffected by this restriction. Because of the risk of friendly casualties, mortars may never fire on a hex to which one or more friendly units are adjacent, and assaults on a hex may not be combined with normal fire against that hex.

The British may automatically call down mortar fire on one enemy occupied hex or two mutually adjacent enemy-occupied hexes each turn, as long as a fresh spotting unit can trace a line of fire to the hexes concerned. Vacant hexes may not be engaged. When British mortars fire, the shell burst marker is placed in or between the targeted hexes (regardless of the result), and remains there as a reminder until the following British fire phase. The Germans may dice at the start of their fire phase to obtain support from an off-map mortar platoon represented by a die rather than a counter. The first time they call for support, it is available on a roll of 2 or more, but each time the call succeeds, the die roll needed to obtain support on a future turn rises by 1, as recorded by which face of the mortar die is displayed. Hence, after three previous bombardments, the mortars would only be available on a roll of 5 or 6, and after five bombardments they cease to be available altogether. When German mortars fire, they engage one or two hexes just like the British mortars, but with no need to mark the targeted hexes.

LINES OF FIRE

Rifle and machine gun platoons may fire only if they can trace a line of fire to each target hex at the time their fire is declared. Mortar platoons may fire indirectly from off board against any hex or pair of adjacent hexes on the map, but only if a single fresh (not spent) friendly platoon can trace a line of fire to both target hexes when the fire is declared. The fresh spotting unit may conduct its own fire attack later that phase, perhaps against the same target hex or hexes if this is announced in advance. Lines of fire may be a maximum of five hexes long, counting the target hex but not the firer's hex. They are blocked if an intervening hex contains any terrain feature. Intervening hexes containing one or more friendly platoons also block lines of fire, unless spotting for mortars or unless the firer or target is on a ridge. Note that lines of fire to or from ridges are still blocked by intervening farm, wood or ridge hexes. To determine if a hex blocks the line of fire, find its position in the hex grid relative to the firer's or target hex (whichever is closer), and then consult Figure 11.2 to see whether the other hex does or does not lie in the obscured area. The four lighter shaded hexes in the diagram represent partially obscured hexes. Lines of fire are blocked if they are totally obscured by any intervening hexes, or if they are partially obscured by two or more different intervening hexes. (Hence, units could fire along the side of one adjacent obstruction, even along the side of the map, but not in between two such obstructions.)

FIRE EFFECTS

The fire of each platoon is resolved by rolling a die. If firing on two adjacent hexes, a separate die is rolled for each hex and the effects of that fire are applied in full before dicing for the other targeted hex. The die roll is reduced by one if the target hex contains any terrain feature (unless firing mortars), and it is also reduced by one if the line of fire to that hex is partially obscured by an intervening hex (including when spotting for mortars) or if firing on a non-adjacent hex to which a friendly rifle platoon from a different company is adjacent. These three adjustments are cumulative, and machine guns do suffer from the third modifier, so the most efficient way of covering units as they close with the enemy is with the fire of other platoons of the same company. Rifle platoons achieve a hit if the modified score exceeds (not just equals) the range in hexes to that hex, counting the target hex but not the firing hex. Hence, a rifle platoon engaging a woods hex at three hexes range would score a hit on an unmodified roll of 5 or 6 because of the −1 deduction for the wood. Machine gun and mortar platoons achieve a hit if the modified score is 2 or more, regardless of the range, although British mortars whose shell burst marker is on the map from last turn have their die roll reduced by one against hexes they did not target last turn. This penalises the British for continually switching mortar targets unless they leave a turn fallow for retargeting.

When a hex is hit, all platoons in the hex become spent if not already so. Each successful normal fire attack inflicts one casualty point on every platoon in the hex, although one platoon per hex escapes this casualty point if it is dug in and/or occupies a farm hex. When a unit assaults a single adjacent hex, a hit instead inflicts three casualty points if there is a single unit in the hex, while if there are two or more platoons present, the hit automatically breaks and removes one of the platoons (owner’s choice), without inflicting casualty points on the remainder. Hence, units can choose to focus on pinning down two hexes of nearby enemies with normal fire or on causing higher casualties in a single adjacent hex with an assault. Farms and entrenchments do not reduce the casualties suffered in assaults. Overall casualty

points accumulated by each side are recorded using a spare die, and as soon as the total exceeds six, it is reduced by six, and one platoon of the owning player’s choice that has sustained a casualty point during this fire phase is broken and removed from play. The unit removed need not be in the current target hex as long as it suffered a casualty point earlier in the fire phase. Broken units still have most of their personnel, but their combat effectiveness has been fatally compromised, so they are removed altogether for the sake of simplicity.

Each fire attack by a British platoon (including the mortar and machine gun platoons) is counted using a spare die to record the overall total of such attacks by the British forces as a whole. Attacks by a given unit on two adjacent hexes count as a single attack for this purpose, as do assaults. When the total exceeds six, it is reduced by six, and the current firing platoon is assumed to have run low on ammunition and is removed from play after applying the results of its fire, as if it had retired into permanent reserve. British players will wish to sequence their fire attacks so that this removal of firing units causes the least disruption. Machine gun and mortar platoons may be removed in this way just like rifle platoons, and spotting units may not be removed instead. German platoons are not subject to this depletion of ammunition, so they may fire every turn without penalty.

RECOVERY

By their recovery phase, most or all friendly platoons will have been flipped to their spent side, either because they were pinned down by enemy fire or because they have just moved or fired themselves. Spent units are prohibited from moving or firing, but during the friendly recovery phase, they all automatically become fresh again, and their counters are flipped back to show this. It hence requires continuous fire to keep enemies pinned down until they can be permanently eliminated.

VICTORY

The game is played for twelve turns (representing up to two hours of fighting), as recorded using two spare dice. At the end of the German player turn on turn twelve (there is no final British player turn), the Germans score one point for each British unit broken and one point for each German unit still on the map, while the British score one point for each German unit broken and one point for each fresh British unit which occupies a German board edge hex. The side with more points wins a game victory, and the bigger the margin, the more decisive is the triumph.

INITIAL SETUP

Once terrain features have been diced for and laid out, the Germans get the choice of which half of the map to defend, so that they may take advantage of local terrain when establishing their line. They then deploy their six dug-in rifle platoons in any or all of the three lateral hexrows (24 hexes) in their own half of the map, as illustrated in Figure 11.1. Platoons may stack with other platoons from the same company if desired (although it is not recommended). Once the Germans have been deployed, the British forces may be set up in any or all of the eight hexes on the opposite board edge, as long as different companies occupy different hexes. The machine gun platoon may stack freely in any of the eight hexes. Both sides may leave one or more platoons in reserve behind their board edge if desired. Once both sides have deployed, every German-occupied hex within the line of fire of any British unit is subjected to a preliminary artillery bombardment. A die is rolled for each hex, and on a score of 5 or 6, every platoon in the hex becomes spent and suffers one casualty point (with no tracking of ammunition expenditure and no exemption for being dug in or in a farm). Play now begins with the first turn. (The effectiveness of the initial artillery bombardment may easily be varied between automatic hits and complete ineffectiveness so as to shift the balance of the game, and one possibility is for both commanders to bid successively for sides once the terrain has been determined but before deciding the direction of play. The higher bidder commands the British, but must roll at least as high as the final bid in order to hit each bombarded hex.)

EXAMPLE OF PLAY

The players start by rolling two dice for each hex, proceeding from left to right along each lateral hexrow in turn. This produces the random terrain illustrated in Figure 11.1. Ten terrain features are created, which is only two more than the expected average of eight (one-sixth of 48). However, the distribution of terrain types is much more skewed, with no fewer than five rolls of double 6 producing an unusually built-up battlefield with several farm complexes. The Germans now have the privilege of choosing which half of the map to defend, and they opt for the bottom half because it has six of the ten terrain features arrayed in a neat crescent providing ample cover and dead ground. It is annoying that one farm and one wood lie just outside their deployment area, but troops deployed here would be very exposed to suppressive covering fire in any case, so it is probably better to ambush British forces once they enter them.

The right-hand side of the battlefield clearly offers the British better covered approaches than the exposed farmland on the left, so the Germans decide to weight their defence towards the right to compensate. As shown in Figure 11.1, the 1st Company is strung out in the woods on the left, while the 2nd Company guards the farms on the right. Platoon 1-c is held back in the dead ground in the centre, ready either to provide flanking fire to shield Platoon 1-a or to redeploy to bolster the 2nd Company's defence. Platoon 2-c is also kept in dead ground ready to ambush enemies entering the farms, while the other two platoons of 2nd Company form a thicker line on the right to guard against encirclement and to stop the farms being overwhelmed by sheer force of numbers. Platoon 2-b is deployed in front of rather than atop the ridge, so as to maximise its field of fire, avoid exposure to overhead fire, and deprive the British of any dead ground along their board edge through which they could advance concentrated forces. No platoons are held off the map, since this would forfeit the advantages of being dug in.

The British now get the chance to tailor their own offensive deployment to exploit any weaknesses revealed by their initial reconnaissance. Pushing down the right side of the map is problematic because of the firm defence by 2nd Company, while advancing on the left of the map is dangerous due to the inability to suppress the crossfire from Platoon 1-c, so they decide instead to

focus on taking the central farms through a step by step offensive. The Vickers machine guns are deployed on the ridge to provide overhead covering fire, while two platoons each from A and B Companies are spread out on either side of the ridge to help suppress Platoon 1-a and to spearhead the advance against Platoon 1-b. There is no need yet to pin down 2nd Company on the right of the map, but Platoon C-1 is deployed in the farm at the outset so as to widen the initial artillery bombardment, since the farm buildings will shield the platoon from casualties just as do the German entrenchments. The remaining seven rifle platoons are left in reserve for now so as to minimise overcrowding and to keep the Germans guessing as to how the attack will develop. German Platoons 1-a, 1-b, 2-a and 2-b are all in the line of fire of British units, so all four hexes now test for the preliminary artillery bombardment. With die rolls from left to right of 6, 1, 4 and 3, only Platoon 1-a becomes spent and suffers a casualty point.

Turn one begins with the German movement phase. The Germans can see the danger of being defeated in detail if they leave Platoons 1-a and 1-b to be overwhelmed while their other four platoons stand idly by. One option would be to pull Platoon 1-b back to join Platoon 1-c, and to rely entirely on an ambush defence of the central farms. However, this would allow the British to advance quickly through an open corridor of dead ground outside the visibility range of Platoon 1-a, so the Germans decide instead to take a more active approach and to push Platoon 2-c out of its foxholes and into the farm in front. The unit’s dug-in counter is replaced by that showing the normal infantry graphics. The rest of 2nd Company will probably need to move left in due course to provide a second line of defence, but for now they are left in place. In the fire phase, the Germans decide to call on their precious mortars to cover the forward move, and they successfully obtain support on a roll of 4 and rotate the mortar die to show a score of 3 or more required in future. Platoon 1-b directs the mortars to bombard the Vickers guns on the ridge and the adjacent Platoon A-1, and it also announces that it will be engaging Platoon A-1 itself later, just in case. The mortars roll a 2 against the ridge, and with no modifiers they just manage to pin down the Vickers guns and inflict a casualty point on the British. They also pin down and inflict a casualty point on Platoon A-1 with a roll of 4. Platoon 1-b

itself now fires on the two A Company platoons, needing a roll of 4 or more because of the three hex range. On a score of 3 it fails to inflict a further casualty point on the already spent Platoon A-1, but on a roll of 6 it pins down and inflicts a third casualty point on Platoon A-2. Platoons 2-a and 2-b may as well engage Platoon C-1 in the farm, needing a score of 5 or 6 to hit because of the buildings and the three hex range. With rolls of 5 and 6 they both get lucky and make the enemy spent, but no more casualty points are inflicted because the farm buildings negate them in each case. In the recovery phase, all five of the spent German units are flipped back to their fresh sides.

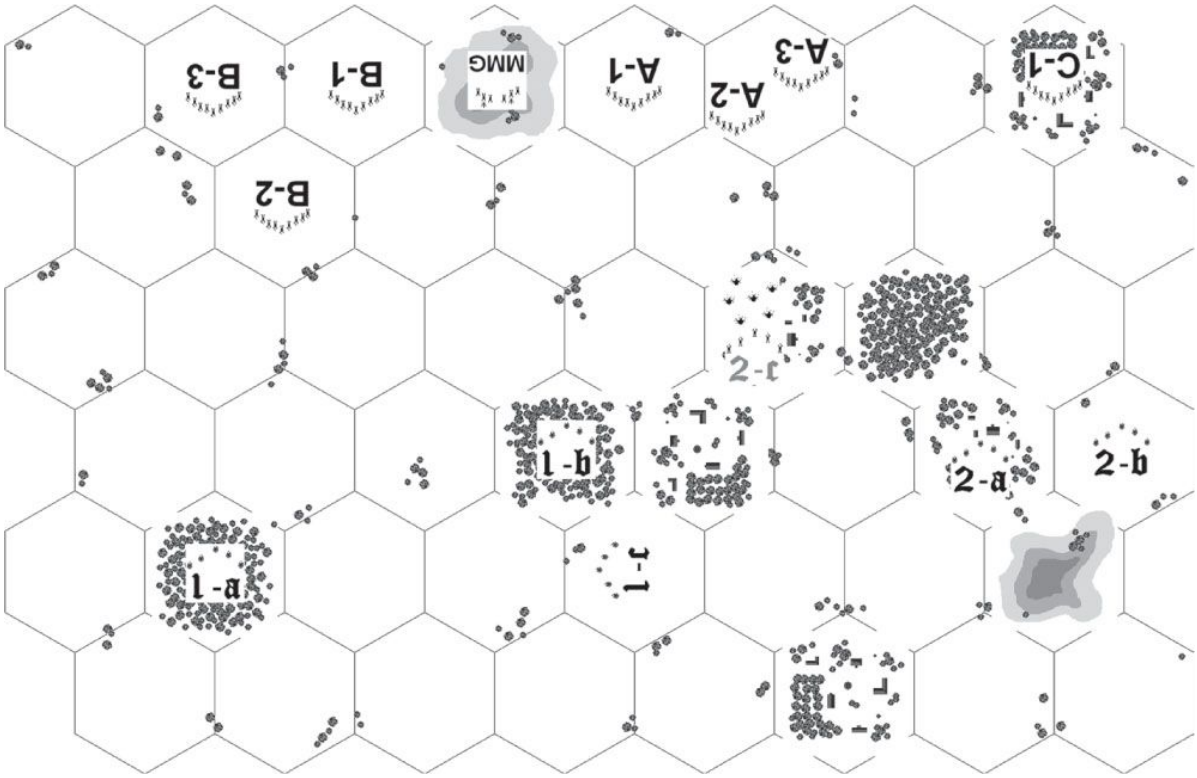
The British start their first player turn with only two of their six units on the map free to act. In their movement phase, they advance Platoon B-2 to bring it closer to its targets, and they enter Platoon B-3 in the vacated hex. They also take the risk of bringing on Platoon A-3 in the hex already occupied by the spent Platoon A-2. In the fire phase, the only remaining fresh British unit on the map is Platoon B-1. This unit first spots for a mortar attack on Platoon 2-c, which only just succeeds with a die roll of 3 because of the −1 modifier for the line of sight being partially obstructed by the ridge. Although the target unit is no longer dug in, it escapes casualties because of the farm. The shell burst marker is placed in the target hex. Platoon B-1 then conducts its own fire attack against Platoon 1-b, but narrowly fails with a roll of 4 because of the −1 terrain modifier. The two British fire attacks are recorded on the ammunition die. In the recovery phase, all eight British units on the map become fresh, and the turn die is rotated to mark the start of turn two.

Figure 11.3 shows the position at the start of turn two, with just one German platoon spent. Moving Platoon 1-c up into the adjacent farm would merely crowd the defending line and leave it just as vulnerable to suppression, so the Germans proceed straight to their fire phase. They opt again to call in mortar support, and just obtain it on a roll of 3, at the cost of the required roll rising to 4 or more in future. They decide to use the mortars against the crowded target of A Company, with Platoon 1-b as the spotting unit. The roll against Platoon A-1 is 1, so does not score a hit. Against the other hex the score is 5, so both platoons in the hex become pinned and suffer a casualty point each, bringing the total

to five. Platoon 1-b would like to use part of its own fire against the unsuppressed Platoon A-1, but having not announced this in advance, it targets the ridge and Platoon B-1 instead, with Platoon 1-a also declaring its intention to engage Platoon B-1 in due course. A roll of 4 just fails to hit the Vickers guns because of the −1 modifier for the ridge, but a score of 6 well and truly suppresses Platoon B-1 and inflicts the sixth British casualty point. Platoon 1-a now fires, failing to inflict additional casualties on Platoon B-1 with a roll of 2, but pinning down and scoring a seventh casualty point on the closer target of Platoon B-2 with a roll of 5. The British now rotate their casualty die back to 1, and one of the four units which have suffered casualties this turn must be broken and removed. The British choose to lose Platoon B-1, so as to keep A Company intact for the main attack. On the right, the German 2nd Company platoons again have no alternative but to try to keep Platoon C-1 pinned down in the farm, and this time they fail to do so with rolls of 3 and 1. Finally, all five spent German units become fresh again.

The British begin their second player turn with four on-map units fresh, so they are starting to win fire superiority despite the losses they have suffered. In their movement phase, they decide to press the attack by advancing Platoon A-1 towards the nearby farm and bringing the lead platoon of D Company into the vacated hex. They also take the risk of bringing on Platoon C-2 alongside the farm. In the fire phase, the mortars cannot continue engaging Platoon 2-c because of the proximity of friendly troops. The Vickers guns on the ridge fire over the heads of the advancing infantry instead, but their roll of 3 is not quite enough to succeed because of the −2 modifier for the farm and the proximity of Platoon A-1. The British seek solace by shifting the mortars to bombard Platoon 1-b, with Platoon B-3 providing the spotting since the intervening Platoon B-2 does not block such spotting as it would block direct fire. (The mortars cannot also engage Platoon 1-c, even though it is adjacent to the target hex, because the woods conceal it from the spotting unit.) On a roll of 5, Platoon 1-b is well and truly suppressed despite the −1 modifier for switching targets, but this brings the running total of British fire attacks to four. Platoon B-3 does not itself fire against the only available target of Platoon 1-A, since there is no chance of success because of the −2 modifier due to the wood and the partial obstruction produced by Platoon B-

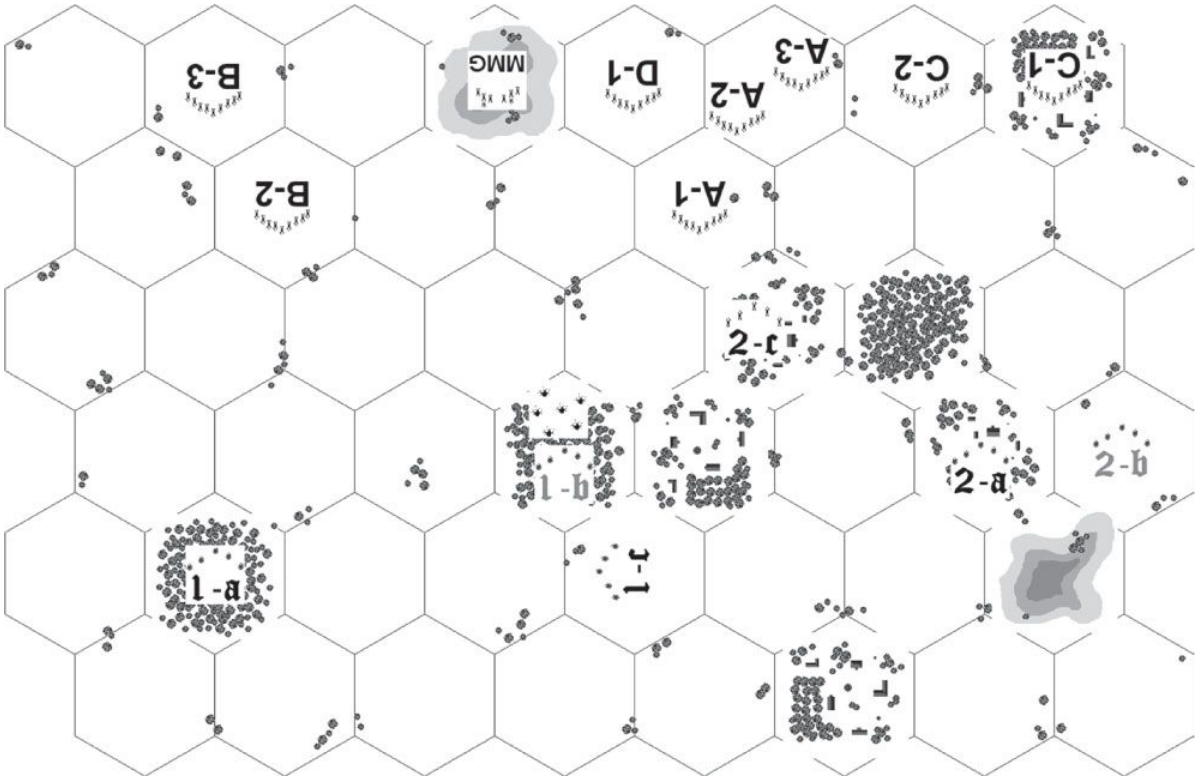
2, and since even a slim chance of success would not be worth the further ammunition expenditure in any case. However, Platoon C-1 does engage the closer and more concentrated targets in 2nd Company, to shield Platoon C-2 from fire. On a roll of 3, Platoon 2-a in the farm escapes unscathed, but on a roll of 6, Platoon 2-b is pinned down, thereby ensuring the safety of Platoon C-2. This raises the running total of British fire attacks to five, so the second unit that fires next turn will run low on ammunition and have to be removed. In the recovery phase, all seven spent British units become fresh once again, and the die is rotated to show the start of turn three.



11.3 *Fire and Movement* example 1

Figure 11.4 shows the position at the start of turn three. A-Company is looking highly vulnerable, especially if the German mortars are still available this turn, but in due course Platoon 2-c is likely to be overrun by the mass of advancing units, and the British can then move on to tackle Platoon 1-b while the mortars suppress flanking fire from Platoon 1-a. The stage will then be set for a coordinated British push through the central woods and farms, which will sustain further losses at the hands of ambush attacks

from Platoons 1-c and 2-a but which should eventually be able to overwhelm this fairly thin defence given that each German attack has only a two in three chance of success against the covered terrain. The real enemy for the British is time, which is why they pushed forward so aggressively in the first two turns despite the losses this entailed. The system delivers an object lesson in how hard it can be to overcome an optimum density defence (as illustrated in Figure 6.1), since crowding more attackers into the fight may simply lead to them being pinned down and slaughtered en masse. By contrast, the weak German 88th Division at Korsun had only eight assorted battalions to defend its 35 km front (less than one company for each sector of the size represented here, even with no forces held in reserve), so it is not surprising that it was unable to hold the line.[42] The system also shows the importance of support weapons such as machine guns and mortars, and it helps one to understand why tanks were so valuable in the attack, since they could concentrate combat power regardless of enemy small arms and mortar fire and could carry much more ammunition than the infantry could manage on foot. Of course, if tanks were added to the system, then there would also have to be provision for countermeasures such as antitank guns, mines and Panzerfausts, so there is always a price to be paid in terms of the balance between accuracy and simplicity, as discussed in Chapter 2.



11.4 *Fire and Movement* example 2

A particular subset of land combat that has become a major preoccupation in modern times is urban warfare. Growing urban populations provide the combatants for ‘war among the people’, and urban terrain hinders modern weapons and so allows less well-equipped forces to hold their own (as in the fighting in the Libyan city of Misrata, which is raging as I write).[43] No fewer than six of the more contemporary simulation projects chosen by my MA students have focused on the urban battles in Algiers in 1957, Beirut in 1983, Mogadishu in 1993 and Fallujah in 2004.[44] Urban combat is a popular topic for first-person computer games, and there are also lots of board wargames that focus on the bitter contests for cities such as Stalingrad, Arnhem and Hue.[45] Hence, I have produced a simple variant of my *Fire and Movement* system to simulate urban warfare in World War Two, thereby illustrating how easy it is to tweak manual simulation designs to cover whatever topic is of interest.

One key difference that urban terrain makes is that force to space ratios increase because fields of fire are so constrained. Hence, the battalion-strength British force defending Arnhem bridge in 1944 occupied an enclave just over 300 metres square –

a block of only four hexes in *Fire and Movement* terms.[46] Attacking forces could be just as concentrated, with German divisions containing up to nine battalions attacking on frontages of only a few kilometres each at Stalingrad, although the physical difficulty of squeezing so much firepower into the frontline at once given the many obstructions in the urban environment doubtless helps to explain why it was so difficult to overcome determined defenders.[47] Even computers struggle to capture the full 3D complexity of urban terrain, while boardgame representations range from ultra-complex systems that track the size, resilience and number of storeys in individual buildings to much broader brush treatments that simply divide the city into large irregular areas, each with a single composite terrain modifier.[48] Although this last approach would fit best with the scale of *Fire and Movement*, I wanted to reflect more directly the key variation within the urban environment, namely the difference between the buildings, on one hand, and the open spaces of roads, gardens and courtyards, on the other. John Hill's classic *Squad Leader* system models this distinction by having city streets occupy chains of hexagons to themselves, but only by 'fudging' the ground scale, since each of his hexes supposedly represents an area 40 metres across.[49] I decided to use a square grid instead because of its greater compatibility with city blocks, and to have each square represent a more realistic fifteen metres across, so that the entire map corresponds to less than one hex on the *Fire and Movement* map.[50]

Despite the greater force densities in urban warfare, such a small area of a city would typically be defended only by a couple of platoons rather than the two companies in the *Fire and Movement* simulation. This can be handled by using exactly the same six defending counters, but simply treating each one as representing a section rather than an entire platoon. Similarly, the attacking units may be treated as sections rather than platoons, giving the attackers the equivalent of a reinforced company instead of an entire battalion. For the sake of simplicity, I leave aside the mortar and machine gun units in view of the difficulty of employing them at such close quarters, and I also omit the dug-in variants of the defending counters, given the equivalent protection afforded by the buildings themselves. Rules for ammunition depletion are left out

as well, because each turn represents a much shorter period of action than in *Fire and Movement* (albeit with long accompanying delays), and because both forces are assumed to have stockpiled lots of ammo in their initial positions on opposite sides of the same street. This does produce a seemingly endless succession of fire attacks, but winning fire superiority is the dominant element of the contest, and one should not necessarily imagine troops blazing away constantly throughout the game – what matters is establishing which side's forces at any point are actively training their weapons on enemy positions waiting for a target to appear, and which side's men are cowering behind the walls and so securing temporary safety at the expense of becoming vulnerable to a grenade lobbed through the window by adversaries able to approach to close range.

In the plates section, I have provided a map of a typical residential block and the surrounding streets for players to photocopy and use, but to prevent play becoming too stereotyped, I use a similar die roll system as in *Fire and Movement* to remove around one-sixth of the buildings at random and so to provide a different tactical challenge each time. The British *Infantry Training* pamphlet from 1944 provides several pages of hints and diagrams on techniques for attacking urban areas, including the principle of leapfrogging down a street by having each section clear a house and then provide covering fire from that position for another section to clear a house on the opposite side of the street.[51] German doctrine of the time recommends similar use of the streets and squares as fire lanes for mutually supporting defensive positions.[52] The simulation illustrates exactly these dynamics, and presents both attackers and defenders with challenging interactive dilemmas regarding the positioning and use of their forces. The attackers are given 50 per cent more turns than in *Fire and Movement*, but they need to strike a very difficult balance between waiting interminably for all the defending positions to be suppressed at once or pushing forward into the streets and facing the grave risk that their leading troops will be cut down in their tracks. This is where the random element and the play sequence from *Fire and Movement* come into their own. Even once the attackers seize some buildings in the target block, the platoon concerned may be too weak to exploit further, producing exactly

the kind of close range room to room standoffs characteristic of urban warfare. I will now present the full rules as usual, so that you may try the variant for yourselves.

Block busting

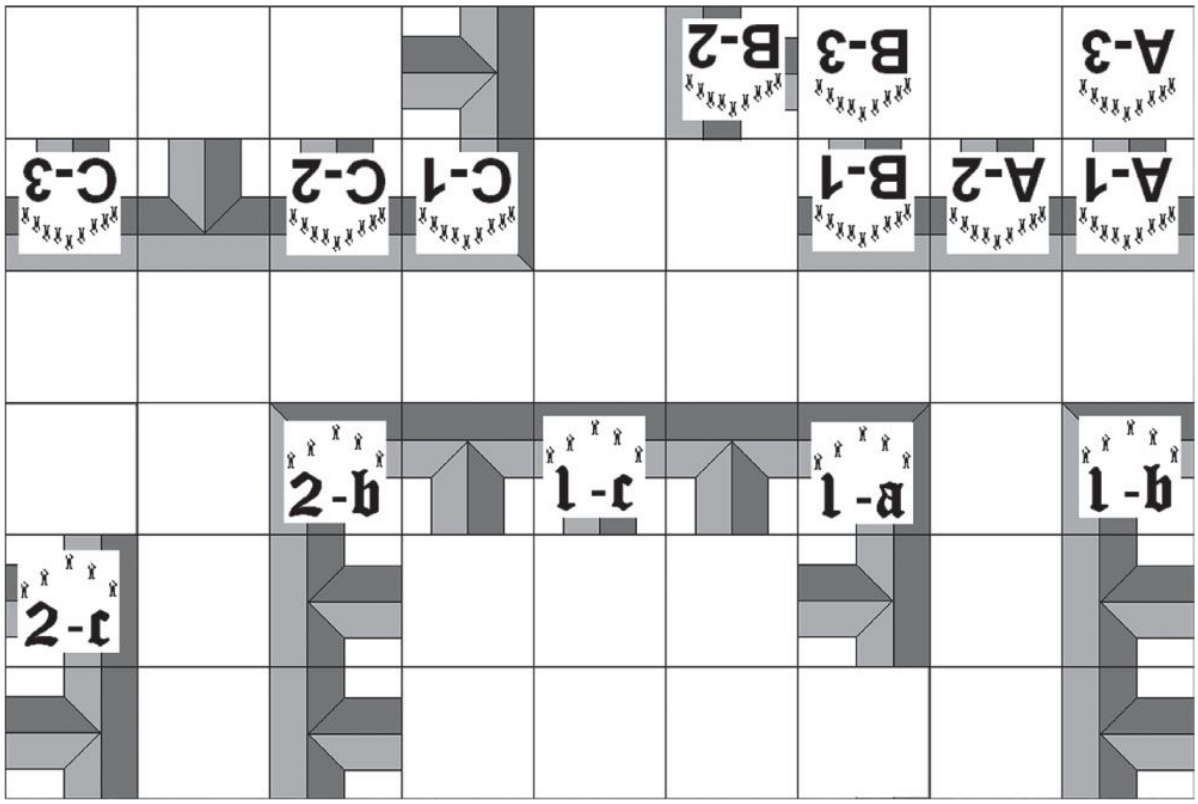
INTRODUCTION

This is a simple tactical simulation game of an attack by a reinforced infantry company on enemy positions in an urban area during World War Two. Two players or teams direct the actions of the attacking and defending forces as they seek to capture or defend territory and to inflict losses on the opposing forces while minimising their own losses. Team play is best with six participants, so that one player may command each platoon while one player on each side doubles up as the overall commander. The simulation may also be played solitaire to study the dynamics involved.

THE MAP

Action takes place on a map of typical urban terrain, as shown in Figure 11.5.

The map is covered with a 9 x 6 square grid, and all units on the map must occupy a specific square. Each square represents an area around fifteen metres across (so that the troop figures on the counters are actually 30 per cent underscale). Squares only adjoin one another orthogonally, never diagonally. Twenty-five of the squares contain two- or three-storey residential buildings, while the remaining squares contain open streets or backyards. To provide variability, a die must be rolled for each building square before play begins, and if the score is a 6, that square is covered by a blank counter to show that it counts as open terrain instead. The nine squares along each of the top and bottom map edges are board edge squares for the respective sides. Units may start off in or move back into reserve behind their own board edge, and the attackers receive victory points for occupying the enemy board edge.



11.5 *Block Busting* map

THE PLAYING PIECES

Each side has a number of units, represented by double-sided counters as shown in Figure 11.5. The attackers have twelve rifle sections each containing up to a dozen soldiers. The defenders have six depleted rifle sections. The rifle sections on both sides are organised into platoons, each containing three sections. The attacking platoons are lettered (A, B, C and D), with individual sections numbered. The defending platoons are numbered (1 and 2), with individual sections shown by small letters. One side of each counter shows the section ‘fresh’ (with dark text), while the other side shows the section ‘spent’ (with lighter text). Units become spent through moving, firing, or being pinned down by enemy fire.

SEQUENCE OF PLAY

The game is played in turns, each representing one minute of action plus a variable but usually much longer period of delay due to command problems in the tangled urban environment and the difficulty of getting troops to risk exposing themselves with the enemy so close. Each turn contains two player turns, with the defending player turn occurring first. Each player turn proceeds through three phases:

1 movement phase
2 fire phase
3 recovery phase.

MOVEMENT

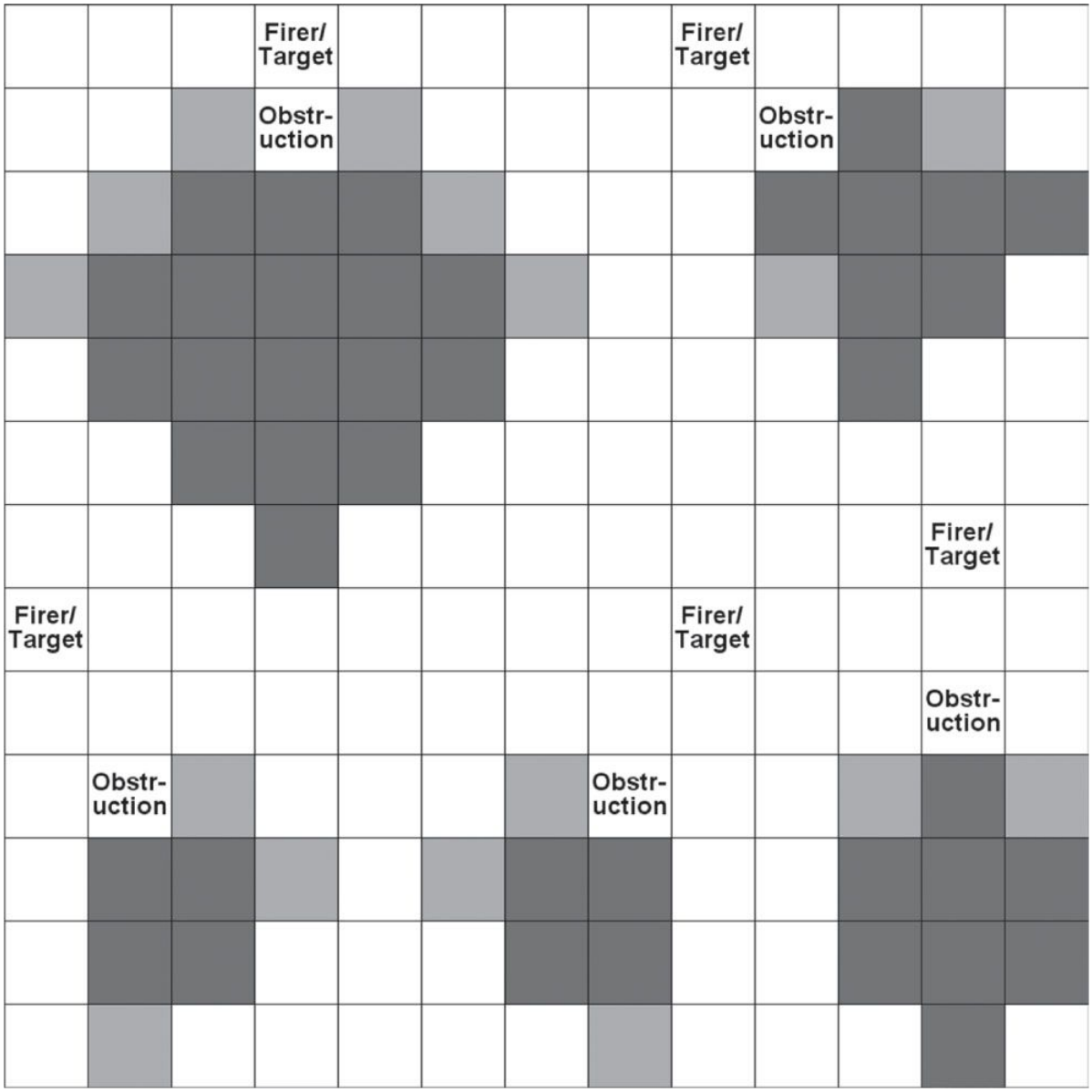
In its movement phase, each fresh friendly section may move if desired, becoming spent in the process. The unit may either enter an adjacent square of any type, or may move through one adjacent open square and into a second open square adjacent to that (not necessarily in the same direction). Diagonal moves are prohibited, so a unit would have to make two orthogonal moves instead. Spent sections may never move. Sections may move in any order, but they may never enter or pass through a square that already contains an enemy or friendly unit, so there may only ever be one section per square. Fresh sections that start their move in any of the nine friendly board edge squares may move off the map into reserve, but they may never re-enter the map and must be placed to one side. Fresh sections that start their movement phase in reserve may move onto any of their nine board edge squares, and if the entry square is open terrain, the section may continue on to a second open square.

FIRE ATTACKS

In its fire phase, each friendly section that is still fresh may fire on one or two enemy occupied squares to which it can trace a line of fire, becoming spent in the process. Each section may fire either on a single square or on two mutually adjacent squares. Sections fire individually in any order and their attacks must be resolved fully before turning to the next firing unit, but all sections firing on a given square must be specified before any of them fire, and their fire may not be cancelled or supplemented, regardless of the initial results achieved. Sections from different platoons may never fire on the same square in a single fire phase.

LINES OF FIRE

Sections may fire only if they can trace a line of fire to each target square at the time their fire is declared. Lines of fire may be a maximum of six squares in length, counting the target square but not the firer's square, and measured by adding the distances in each orthogonal direction. Fire is blocked if an intervening square contains buildings, or if the firing unit is in the open and an intervening square contains another friendly section. (This allows units in buildings to provide overhead covering fire from the upper storeys.) To determine if an intervening square blocks the line of fire, find its position in the grid relative to the firer's or target square (whichever is closer), and then consult Figure 11.6 to see whether the other square does or does not lie in the obscured area. The lighter shaded squares in the diagram represent partially obscured squares. Lines of fire are blocked if they are totally obscured by any intervening squares, or if they are partially obscured by two or more different intervening squares. (Hence, units could fire diagonally out of a row of buildings, but not along the diagonal between two building squares or across a continuously terraced street at a house two squares down on the other side.)



11.6 *Block Busting* lines of fire

FIRE EFFECTS

The fire of each section is resolved by rolling a die. If firing on two adjacent squares, a separate die is rolled for each square and the effects of that fire are applied in full before dicing for the other targeted square. The die roll is reduced by one if the line of fire is partially obstructed by a single intervening square. The score is also reduced by one if firing on a non-adjacent building square to which another friendly section is adjacent (because of the risk of hitting friendly troops), or if firing from one building square on an adjacent building square (because of the lack of connecting doors and windows). These adjustments are cumulative. If the modified roll is 2 or below, the fire has no effect except that targets in the open automatically become spent if not already so. If the modified score is 3 or more, targets in the open are broken and removed from play, while targets in a building become spent, or are broken and removed from play if they are already spent and the firer is adjacent. Hence, the only way to remove sections in buildings is through two or more successful attacks on them in the same turn, the final one by an adjacent unit. Broken units still have most of their personnel, but their combat effectiveness has been fatally compromised, so they are removed altogether for the sake of simplicity.

RECOVERY

By their recovery phase, most or all friendly sections will have been flipped to their spent side, either because they were pinned down by enemy fire or because they have just moved or fired themselves. Spent units are prohibited from moving or firing, but during the friendly recovery phase, they all automatically become fresh again, and their counters are flipped back to show this. It hence requires continuous fire to keep enemies pinned down until they can be permanently eliminated.

VICTORY

The game is played for eighteen turns, as recorded using three spare dice to count down the number of turns remaining, including the present one. At the end of the defending player turn on turn eighteen (there is no final player turn for the attackers), both sides are assumed to consolidate in their current positions through exhaustion and shortage of ammunition. The defenders score one point for each attacking unit broken and one point for each defending unit still on the map, while the attackers score one point for each defending unit broken and one point for each fresh attacking unit that occupies an enemy board edge square or is adjacent to an enemy board edge square containing a fresh attacking unit. The side with more points wins a game victory, and the bigger the margin, the more decisive is the triumph.

INITIAL SETUP

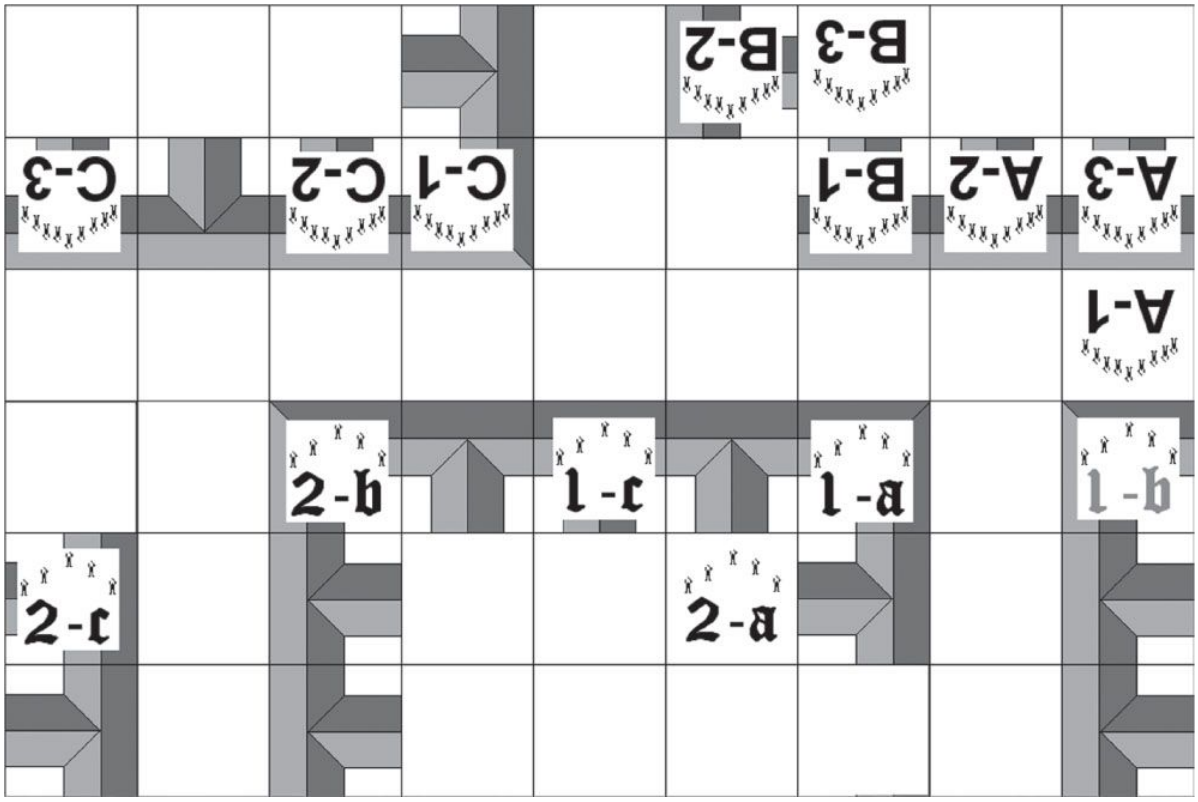
Once each building square has been diced for to see whether it becomes open terrain, the defenders deploy their six sections in any remaining building (not open) squares in their own half of the board, after which the attackers deploy their twelve sections in any building or open squares within two squares of their own board edge, as shown in Figure 11.5. Only one section is allowed per square. Both sides may leave one or more sections in reserve behind their board edge if desired. Play now begins with the first turn.

EXAMPLE OF PLAY

The players begin by dicing for each building square, with the result that two squares in the defenders' half of the map and one square in the attackers' setup area revert to open terrain. The defenders deploy Platoon 1 in forward positions on the right of the map, and Platoon 2 slightly further back on the left of the map, with Section 2-a held in reserve off the board ready to reinforce either platoon as required, and with no sections in adjacent squares, so as to minimise exposure to fire. The attackers study the map and decide that Platoon 2's position is too dangerous to assail because of the wider open space to be crossed, so they deploy Platoons A and B on the right of the map instead, while using Platoon C to tie down Platoon 2, and keeping Platoon D off the map in reserve ready either to charge down the central street, to move in behind Platoons A and B, or to push forward on the left of the map after all should Platoon 2 redeploy en masse to support Platoon 1. Platoons A and B each hold back one section ready to fill in behind assaulting sections. This produces the initial situation shown in Figure 11.5.

Turn one begins with the defenders' movement phase. They decide to commit Section 2-a in a two square move through the backyards, to a flexible position where it can slot in behind Section 1-a in one more turn or move across and slot in behind Section 2-b in two more turns, depending on what the attackers do. In the fire phase, Section 1-b engages Platoon A, with Section 1-a also announcing its intention to engage Section A-2. Unfortunately, Section 1-b fails dismally with rolls of 2 and 1. Section 1-a compounds the problem by rolling only 2 against Section A-2, although it does pin down Section B-1 with a roll of 5. Section 1-c engages the single target of Platoon B-2 (since B-1 and B-2 are not adjacent to one another, and there is a clearer line of fire to B-2), but it continues the run of bad luck with a roll of 1. Section 2-b could not have backed up this attack because of the two intervening squares that partially block the line of fire, so it engages Platoon C instead and suppresses two sections with rolls of 6 and 3. Section 2-c completes the job by pinning down the detached Section C-3 with a score of 4. In the recovery phase, all six defending units are flipped back to their fresh sides.

In their own movement phase, the attackers decide to take a risk and capitalise on the good fortune they have had on the right of the map (where only Section B-1 is spent), so Section A-1 charges across the street and Section A-3 moves in behind to take its place. Since Section 1-c still commands the central street, Platoon D is retained in reserve for now. In the fire phase, Section A-2 fires over the heads of its attacking colleagues and pins down Section 1-b with a roll of 6 despite the −1 modifier for friends being adjacent to the target building. Section B-2 can just trace a line of fire to Section 1-a past the buildings occupied by Section B-1, but on a roll of 3, it narrowly fails to suppress the defenders because of the −1 modifier for the partial obstruction. Section B-3 has no line of fire, so turn one ends with all the attacking units recovering their fresh status as shown in Figure 11.7.



11.7 *Block Busting* example

Section A-1 is now dangerously exposed and faces certain suppression and probable elimination by crossfire from Section 1-a, since the −1 modifier for adjacent friends does not protect targets in the open. The firers may also be able to pin down Section A-3 into the bargain if they roll a further 4, 5 or 6 (because

of the partial obstruction provided by the adjacent building). However, this leaves only Section 1-c in a position to engage one of the other enemy sections on the right of the map, so the attackers should gradually be able to turn the tables in the firefight. (Note that Section 1-c cannot fire laterally down the street at A Company because the angle is far too acute – even the diagonal line of fire to Platoon B-1 is partially obscured by the adjacent building. This illustrates the importance of positions that dominate streets from either end, as Platoons 1-c and A-2 command the streets directly in front of them.) Section 2-a will be vital in creating a second line of defence against Platoons A and B, but once it is committed on the right, the attackers may decide to use Platoons C and D to push into the centre of the enemy block, thereby exploiting the seam between Platoons 1 and 2 to establish a firm foothold that cannot easily be subjected to the coordinated attack needed to eliminate it. With seventeen turns remaining, there is still everything to play for, and a lot of hard decisions lie ahead for both sides.

Just as *Fire and Movement* casts interesting light on the force to space ratio issues covered on a much larger scale in my simulation *Hell's Gate*, so my seventh and final illustrative simulation forms part of a nested set with my other game from Chapter 10, *Big Week*. As I discussed at the start of this chapter, commercial computer games are far better than manual games for demonstrating the fast moving 3D manoeuvres of aerial combat. Simulations such as *Battle of Britain II* and the now outdated *European Air War* are wonderful for transporting students into the heart of massed aerial *melées* like those that occurred during both sides' bomber offensives in 1939–45.[53] The drawback of such computer games (besides unrealistically high loss rates) is that, without an expensive network of high-specification computers with powerful graphics cards, only one student at a time may take the controls, and that the real-time first-person perspective is paradoxically rather *too* blinkered and fast moving to convey clearly some of the broader grand tactical dynamics involved. I do also use *Battle of Britain II* to show a real-time operational display of the evolution of an entire series of raids from an overhead perspective modelled on the famous RAF plotting tables of the

time, and I use John Tiller's PC game *War over Vietnam* to show a similar real-time top down view of how US jets countered enemy air and missile defences three decades later.[54] In both cases, I let the AI run the action automatically, freeing me to talk to the students about the dynamics involved. However, I also wanted to let all the students experience for themselves some of the physical and tactical dynamics of massed air battles, and so for several years I have been using my own manual simulation design for this purpose.

There is a flood of literature on aerial warfare in World War Two, ranging from individual aircrew memoirs and detailed books on particular aircraft types to strategic overviews such as Richard Overy's magisterial study of *The Air War, 1939–1945* .[55] When it comes to the grand tactical dynamics of daylight air fighting over western Europe and the Mediterranean, however, there is not so much directly relevant source material. Mike Spick (himself a wargamer) has written a number of useful works on the history of fighter tactics and on why 'aces' achieve such disproportionate success.[56] Alfred Price is another prolific writer on this topic, and his detailed reconstructions of the course of air battles on 18 August 1940, 15 September 1940 and 6 March 1944 are particularly valuable for present purposes.[57] There are a number of similar secondary studies by other contemporary authors such as Middlebrook, Franks, Freeman and Shaw.[58] Mid-ranking airmen of the time (on both sides) add to our understanding through contemporary doctrinal advice or later memoir literature.[59] In combination, these various sources on different periods of the air war suffice to underpin a generic simulation of the combat dynamics involved. I know of no published manual wargames that cover this grand tactical perspective on the European air war, since existing games tend either to be tactical treatments in which each counter represents a single aircraft, or operational simulations in which each hex represents several miles and each turn represents several minutes of action.[60] Hence, this final game is the most innovative of all in terms of its particular grand tactical focus.[61]

The sources make plain that the dominant operational context in which daylight air combat occurred in western Europe during the long standoff between Dunkirk and D-Day was the interception and

defence of multiengine bomber formations.[62] Although both sides did launch unaccompanied fighter sweeps across the Channel to tempt the enemy fighters into freestanding aerial duels, the usual response of the defenders to these provocations was to ignore them, to the point where the RAF 'Circuses' in 1941–42 included a handful of bombers as 'bait' to try to lure the Luftwaffe into combat.[63] I thus decided to focus my simulation around the escort and interception of a single formation of level bombers. Bomber numbers could be as low as six aircraft (or even occasionally just three four-engine Stirlings) if they were present mainly as bait, but the sources make clear that there was an upper limit of a few dozen bombers per formation even in massive raids like those in the *Big Week* game, because of the sheer difficulty of collecting more aircraft into a single mass.[64] Other bomber formations within the overall stream flew a few miles or more away to the rear or to either side, so it is perfectly reasonable to focus the game only on the moving box of airspace up to two miles in each direction around one selected bomber formation.[65] Keeping the bombers entirely stationary in the middle of the map would mean having to shift all the fighters backwards every round to compensate, so instead I decided to split the map into three sections perpendicular to the direction of flight, and to remove the rear map section and reposition it ahead of the bombers every time they enter the forward map section, hence creating an endless 'rolling map'.

Bomber formations themselves varied considerably in size and shape, and they could be up to 7000 feet wide, 2000 feet long and 3000 feet high in the case of the USAAF combat wing box of early 1943.[66] Most bomber formations (including USAAF ones) were significantly more compact than this, so I opted to represent the bombers by a loose wedge of from one to three units, each around a quarter of a mile across.[67] Building on the approach I discussed for *Big Week* in Chapter 10, I decided to divide the map into quarter mile hexes, allowing the game to be played in ten second rounds and the bombers to move at two hexes per round (thereby covering twelve hexes or three miles per minute). This system is also ideal for the fighters, since it allows them to move at anything between two and five hexes per round and to make up to three 60° turns in each round (representing a maximum turn rate of up to 20°

per second, which is about right for entire flights or squadrons of aircraft using crossover turns at the altitudes concerned).[68] Fighter formations varied in size and shape just as bomber formations did, but quarter-mile hexes are just big enough to accommodate a flight of four planes 150 yards apart in 'schwarm' or 'finger four' array, or larger numbers of fighters in line ahead formations or in more closely spaced arrays such as vics or ketten.[69] Although bigger hexes or fewer aircraft per counter would be preferable to reflect the looser formations used in purely fighter vs fighter combat, the need to tighten up to attack or defend the bombers means that quarter- mile hexes are perfectly acceptable in this context.[70]

What makes most air combat boardgames far more complicated than this one is that they try to reflect directly within their movement and combat systems the fine distinctions between different aircraft types in terms of speed, turn rate, climbing and diving performance, firepower, resilience, and even more subtle variables such as roll rate, visibility, and direct fuel injection.[71] Although these technical differences are certainly important (as shown by the reflection of some of them even in my operational game *Big Week*), it is very difficult to represent them directly in a manual simulation in which artificial hex geometry precludes fine distinctions in aircraft position or facing. It is actually easier to reflect differences between aircraft types in operational games, since this simply requires assigning a different abstract combat strength to the units concerned.[72] Since simplicity and speed of play have to be overriding considerations if a grand tactical manual game is to compete with the much less constrained perspective offered by first-person computer games, I decided to give up altogether on trying to differentiate the strengths and weaknesses of broadly similar aircraft types such as Spitfires, Hurricanes and Me109s or Do17, He111 and Ju88 bombers in 1940.[73] I opted instead to model only the much grosser distinction between 'standard' fighters and bombers and 'heavy' fighters and bombers such as the German Me110 and Me410 'destroyers', the specially armoured FW190 'Sturmgruppen' of 1944, and the USAAF's four-engine B-17s and B-24s.[74] It would be possible to include further special rules for German jets such as the Me262, but since these

saw so little action compared to piston engine fighters, I decided to exclude this marginal element from the simulation altogether.[75]

One reason why I do not try to model fine distinctions between the performance of different fighter types is that the impact of this factor is dwarfed within the very short timescale of the game by variations in the initial energy state of the combatants. Energy comes from a combination of speed and height, and elementary physics allows one to see how these two variables of kinetic and potential energy interrelate. If fighters flying at five hexes per turn (a scale speed of 450 mph) enter a zoom climb and trade speed for height until they slow down to two hexes per turn (180 mph), their altitude gain may be calculated by dividing the difference between the squares of their speeds by twice the acceleration due to gravity.[76] Using the more convenient measure of feet per second, this sum works out at 661 squared minus 264 squared, all divided by two times 32.2, for a total height gain of around 5700 feet. A key aim of the simulation is to familiarise students with these rollercoaster mechanics, which allow fighters sitting safely at higher altitude to dive down and pounce on unwary enemies and then to convert their new found speed back into height by zooming back up almost to their original altitude to escape retribution. To reflect all this, I use the simplest possible system of having four superimposed altitude bands within each hex, each one around 2000 feet in height. Counters occupy these notional hexagonal lozenges of airspace (each around 50 per cent higher than it is wide), and whenever they dive or climb one level, they gain or lose one hex of speed accordingly.[77] As in my *Big Week* game, I was determined to avoid the usual complication of having aircraft attributes recorded in written notes or by separate counters on off-map tracks, so after long experimentation, I finally settled on the expedient of having each fighter unit represented by one of eight double-sided counters, with the counter size showing the unit's altitude, the printed number showing the unit's speed, and the facing showing the unit's heading. The bombers always occupy the second lowest altitude level, except US heavy bombers where one unit occupies the second highest level instead, to reflect the 'stepped' formation used by USAAF combat wings.

The overall energy state of fighters can, of course, change over time depending on whether engine thrust outweighs drag or vice versa. Aircraft flying slowly at full power can execute a sustained climb and gradually gain height without further sacrifices in speed. Sustained climb rates at these medium altitudes would be around 2000 feet a minute, equating to one level every six rounds or so.[78] Conversely, the faster fighters fly and the more tightly they turn, the more energy they lose to aerodynamic drag.[79] More complex boardgames use off-map tracks or writing pads to record incremental changes to speed and height for each individual unit, but, in line with my overriding emphasis on simplicity, I decided instead to use die rolls to resolve fractional energy gains and losses for each unit. Fighters that fly straight at a speed of two accelerate to a speed of three if they roll a 6, while other fighters lose one hex of speed if their current speed plus the number of turns they make that round exceeds three plus a die roll. (Hence, fighters with a speed of three are at no risk of losing energy if they make no more than one turn per round.) Any randomised system such as this is, of course, vulnerable to fluctuations in luck as discussed in Appendix 3, and I did very seriously consider the alternative of recording acceleration and deceleration points collectively for the two sides, as with casualty and ammunition depletion points in *Fire and Movement*. However, this would make energy gains and losses unduly calculable in advance and so make the contest rather too chess like, which is at odds with the real experience of swift, swirling manoeuvres and surprise ‘bounces’. There would also be a tendency with any collective system for players controlling single individual units to hold back and to leave it to someone else’s unit to pay the penalty for pushing accumulated deceleration points over the critical threshold. How to handle spent units to avoid them becoming a dumping ground for collective energy losses would be a further thorny issue. On balance, I think it is preferable in this case to use random techniques to manage energy changes for each unit in its own right, especially since there are only a few active units in the game, so the more die rolls they make, the more chance there is for luck to even out.

Units can normally turn through 60° after entering each new hex, but I restrict this at speeds of four and five because the G

forces would otherwise be intolerable.[80] Heavy fighters can turn through only 120° each round, and they must roll two dice for deceleration and use the lower roll, making them significantly more vulnerable to energy losses when flying fast and turning tightly. Units slow down at the start of their move when climbing but do not speed up until the end of their move when diving, as a simple means of reflecting the slight reductions in horizontal distance covered due to the angle of shallow climbs and dives. I do not even attempt to model the much more complex physics of steep or vertical manoeuvres, because my focus is on entire flights or squadrons rather than individual aircraft. Although my movement system is almost entirely generic, I think it gives a more accurate portrayal of basic aerodynamics than in most other air combat boardgames, for all their intricate details and differentiation by aircraft types.

A further reason why I have eschewed the usual focus on the technicalities of different aircraft types is that air combat (just like ground combat) seems to have been shaped far more by the much less quantifiable human dimension. I showed in Chapter 1 how Lanchester predicted a century ago that numerical advantage would be the key determinant of success in air engagements, based on the operation of his square law.[81] We have plenty of examples of gross numerical asymmetries between escorts and interceptors, whether it be small forces of interceptors attacking heavily escorted bombers (as in the Battle of Britain or in the RAF Circus operations in 1941–42) or large gaggles of interceptors attacking thinly escorted bombers (as in 1944, when the USAAF's phased escort tactics reduced the number of fighters with the bombers at any one time). Lanchester's model would predict that the larger force would win handily in each case. Unfortunately for him, it was usually the smaller fighter force that gave at least as good as it got.[82] This seemingly paradoxical result is, in fact, entirely in line with experience from air combats in other wars, ranging from the western front in World War One (where the Germans routinely achieved more aerial kills despite being outnumbered by roughly three to one) to the jet duels over MiG Alley in Korea (where flights of UN F-86s downed several times as many MiGs as they lost, despite often facing highly adverse

numerical odds).[83] Clearly, Lanchester's reasoning is wrong, and numbers are no guarantee of success in fighter engagements (although they may help to maximise hits on poorly escorted bombers, which was a key reason why Douglas Bader advocated the use of a 'Big Wing' in 1940).[84]

One obvious reason why small fighter forces often achieve disproportionate success is that they may have better pilots. This was clearly the main reason behind the asymmetric kill ratios in the air battles on the Eastern Front in World War Two and in MiG Alley in Korea, as well as in the 'Marianas Turkey Shoot' in 1944.[85] However, an equally important consideration is that numerical superiority may actually be rather counterproductive in fighter combat, since it presents the opponent with a target-rich environment while leaving one's own pilots getting in one another's way and confused as to which of the many aircraft milling around are actually enemies.[86] As I mentioned earlier in this chapter, first-person computer games can illustrate this particular human factor very well, and it is wonderful to see my students wasting time pursuing or even blazing away at unidentified aircraft that turn out in the end to be on their side! In boardgames, it is harder to simulate such misidentification, since the affiliation of the various units is clear for all to see. I do give fighters a combat bonus when engaging enemy fighters that have just signalled their identity by firing their own guns, but the main way in which I reflect the twin factors of pilot quality and force density is by letting each fighter unit represent anything from a single four-plane section to an entire squadron of aircraft, thereby evening out the wide numerical imbalances that existed in reality.[87] From a Lanchestrian viewpoint this is utter anathema, since the square law suggests that such units should differ in fighting effectiveness by an order of magnitude, but actual experience shows that the reality is very different.[88] That is why it is important that operational air games such as *Big Week* inhibit fighters from exploiting superior numbers to gang up on their enemies. Published games that omit such a restriction teach dubious Lanchestrian lessons such as that the best strategy for defenders is to let most enemy raids proceed unmolested while massing defending fighters to overwhelm a chosen few.[89]

I discussed in Chapter 7 how naval and air games often work best when both sides move before combat is resolved, so that the constantly moving craft end up in accurate relative positions at the end of each round when firing takes place. I also mentioned the problem this creates in terms of alternate moves, since whichever side moves second in each round gains a tremendous advantage. Many air combat boardgames seek to resolve this problem by requiring both sides to write simultaneous secret orders for each unit's movement, but besides being very time consuming and making solitaire play and guided competition impossible, the simulation value of this approach is dubious to say the least.[90] First-person computer games show very clearly that most of the time is spent watching and constantly tracking other planes and reacting on a timescale of milliseconds, rather than guessing where the other planes may be in several seconds time. Hence, I opted instead to use a system of alternate player rounds, in which each moving unit fires at the end of its own move if it ends in the same hex and at the same altitude as an enemy formation. Enemy bombers or enemy fighters attacked head on are allowed to fire back at the same time, and I include a special tweak allowing moving fighters to throttle back and stop in their penultimate hex if they reach a firing position, to avoid having to add complex provisions for snapshots in the middle of unit moves. The resulting 'leapfrog' effect of alternating and overlapping rounds not only has the great advantage of simplicity, but it also allows direct reflection of one of the key tactics in air combat, namely the use of certain aircraft to 'cover' others by pouncing on enemies who attack them.

A common position for escort fighters was above and behind the bombers, ready to dive down on interceptors that attacked the bombers from behind. The trouble was that this deployment exposed the slow moving close escort fighters themselves to attack from the rear, so they needed their own protective cover – Spick has a wonderful description of how this logic was carried to extremes in RAF Circus operations, with a close escort squadron covered by a medium escort squadron, itself covered by a high escort squadron, and so on through two more entire wings of fighters (an escort cover wing and a high cover wing) stepped up and back for many thousands of feet above the handful of bombers.[91] The only way to avoid leaving a vulnerable open end in

the chain was to curve it around into a complete ‘defensive circle’, and this common self-protective tactic for outclassed fighters may be simulated directly in the game by arranging three fighter units in a ring at a constant speed of two so that each unit ends its move after two 60° turns in exactly the same position as the unit in front began, and so can fire on any enemy unit that has attacked the ring and also benefit from the added bonus for engaging firing opponents.[92] Defensive circles are unlikely to be formed in the game because they will inexorably drift backwards and lead to the fighters concerned disappearing behind the advancing bombers, but the very fact that this tactic is workable within the simulation is a reassuring indication that the system has captured something of the essence of real air combat dynamics.

The other very welcome feature of the system is that it allows fighters that end their move at the same speed and with the same heading as enemy fighters in their hex to ‘tail’ those enemies and inflict further hits in subsequent rounds, simply by making exactly the same moves as their quarry. The only countermeasures the hapless victims can adopt are to dive away from the battle area and take themselves out of the fight, to turn tightly and so trigger a firing penalty for their attackers, or to manoeuvre so that their pursuing opponents can be ‘sandwiched’ from behind by another friendly unit if they do not break off their attack.[93] The rules handicap units that try to continue attacking other targets once engaged, since survival would be a much higher priority.

The firing system penalises deflection shots and so encourages attacks from directly astern, but against bombers (especially US heavy bombers) with their intimidating defensive guns, the statistically preferable option is for interceptors to launch a series of fleeting head-on attacks instead, even though this requires a long straight approach to give time to line up directly with the bombers’ flight path despite the frightening closing speed.[94] The sources describe vividly how German fighters attacking unescorted US heavy bombers would spend prolonged periods overhauling the bomber formation by some distance before turning in to attack head on and then repeating the cycle over and over again until their ammunition or fuel gave out.[95] In the game, time constraints and the presence of escorts make such drawn-out

tactics impractical, and after an initial head-on pass, the battle usually resolves itself into tangled manoeuvring by both sides' fighters in the wake of the bombers as they seek to conduct or to deter further worthwhile attacks. There are combat modifiers for fighters diving out of or climbing into the sun, to reflect the significant tactical impact of sun position. As in my *Big Week* game, I use the same combat die roll for both sides so that aggressive attacks expose units more to return fire, and I rule that units rolling a 6 when attacking will exhaust their limited stocks of ammunition. Unlike in the *Fire and Movement* game, fighter units that become useless for further offensive action through sustaining hits or running out of ammo remain in play until they can physically leave the map, to avoid undermining the 'cover' and 'tailing' dynamics.

The game is designed so that each student can control a single unit of escorts or interceptors, making it highly suitable for multiplayer use in class. Unlike with *Fire and Movement*, I have left the number and type of units very flexible, so that small groups can minimise playing time by using only as many fighter units as there are players, while those with more time can model massive engagements involving hundreds of aircraft. The simulation brings out very well the initial dilemmas over where the escorts should best be deployed, and the choice between waiting in a vulnerable covering position or sallying forth against the interceptors with the risk that they will flash past and attack the bombers while the outdistanced escorts follow helplessly in their wake.[96] As usual, I will now present the full rules, so that you may try the generic system and develop your own tailored variant to cover any more specific air battle scenario. The game's title, *Angels One Five*, echoes a famous 1952 film about the Battle of Britain, and is the radio code denoting an altitude of 15,000 feet.[97] (As with *Fire and Movement*, the two plates of components and the map segment in Figure 11.11 are designed to be photocopied and printed in black ink onto coloured paper, this time in multiple copies, as described in Appendix 1.)

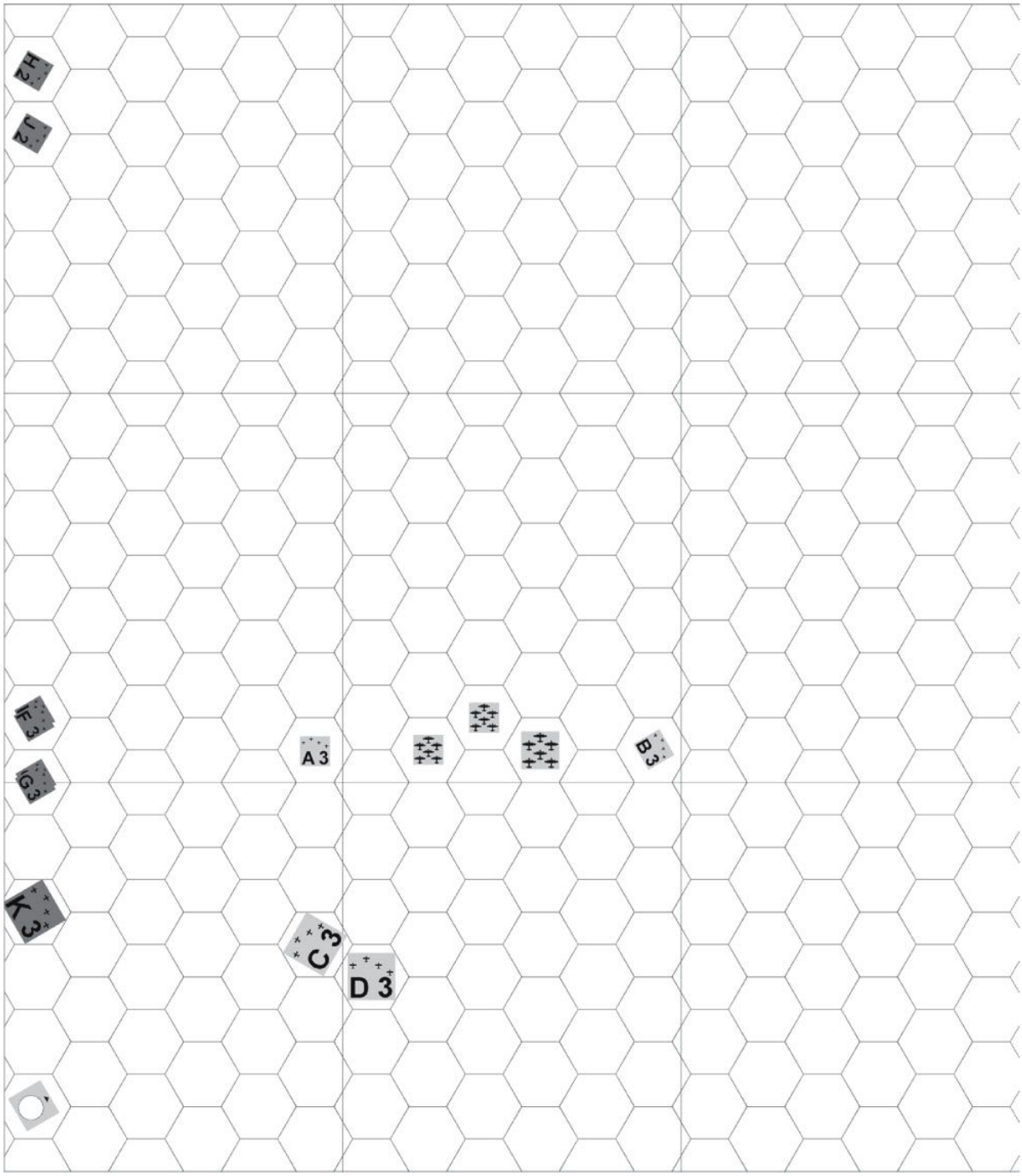
Angels one five

INTRODUCTION

This is a simple grand tactical simulation game of the interception of an escorted formation of multiengine daylight bombers during World War Two. Two players or teams direct the actions of the escorting and intercepting fighters as they seek to inflict losses on the opposing aircraft while minimising their own losses. In team play, each player controls one or more specific fighter units, depending on the number of players and the amount of time available. The simulation may also be played solitaire to study the dynamics involved.

THE MAP

Action takes place on an 18 3 18 hex grid as illustrated in Figure 11.8. The top and bottom board edges are defined as being to the front and rear of the bombers, and half hexes along these board edges are not in play. The map is made up of nine 6 3 6 segments, linked to form three separate 18 3 6 panels at right angles to the bombers' line of flight. At the end of every third round of play, the rear panel is removed and placed as a new front panel, with the other two panels being shifted backwards accordingly. This means that the map will scroll forwards at the same overall speed as the bombers (two hexes per round). Fighter units on the rear panel (including any half hexes) when it is removed are treated as having left the map. Each hex represents an area a quarter of a mile across, and contains four different altitude layers each consisting of 2000 feet of height, with the levels being numbered 1 to 4 from lowest to highest. Hence, the map as a whole represents a rolling block of airspace some four miles long, four miles wide and 8000 feet high, wrapped around the bombers that are themselves between 10,000 and 25,000 feet above the ground. The players must dice for which of the six possible directions is 'up sun' from any given hex, re-rolling to prevent this being directly behind or in front of the bombers, and recording the direction using the counter provided.



11.8 *Angels One Five* map

THE PLAYING PIECES

The attackers have between one and three units of level bombers, with each unit representing between six and eighteen aircraft. These may be designated as twin-engine medium bombers or four-engine US heavy bombers like the B-17 (but not a mixture of the two). Both sides also have between three and ten units of piston engine monoplane fighters, with each unit representing between four and twelve aircraft. Some or all of one side's fighter units may be designated as German heavy fighters such as the Me110. Heavy fighters are badly outclassed in fighter combat and their only compensating game benefit is against heavy bombers, but they may still be used to intercept or escort medium bombers if desired. The wide range in representational ratios reflects differences in the number of aircraft present in the combat and the tightness of their formations. Asymmetries between the representational ratios on the two sides are assumed to be offset by differences in pilot quality and by the greater difficulty that larger forces had in distinguishing friends from foes. Fighter units may become spent by suffering hits or running out of ammunition, and this is recorded by placing a spent marker on the unit for as long as it remains on the map (which should not be for long, as it can make no further positive contribution).

Each fighter unit is represented on the map by one of eight double-sided counters. The counters come in four different sizes, with each larger size corresponding to the next higher altitude band (hence giving an intuitive representation of height, since higher units appear closer and so larger from an overhead perspective). Within each pair of equally sized counters, the four sides show the current airspeed of the unit, which may be two, three, four or five. Units always occupy specific hexes, and are faced at 60° intervals towards one of the six adjacent hexes, as indicated by the aircraft graphics on the counter. Hence, as illustrated in Figure 11.8, selecting and placing a given counter with a particular side up shows the horizontal position, heading, altitude and airspeed of the unit with no need for off-map record keeping. Interceptors and escorts are distinguished by being printed on different coloured paper, and individual fighter units on

each side are identified by a letter from A to K. Heavy fighters may be assigned any desired letters during deployment, and they have both their counters for their current altitude level placed on top of one another on the map to show that they are exposed to fighter attack because of their inferior performance. The spare counters for each fighter unit should be kept in separate piles or in separate boxes of a counter tray so that they may easily be swapped as required. Each bomber unit uses only one single-sided counter, since they never change altitude or airspeed during the game.

SEQUENCE OF PLAY

The simulation is played in rounds, each representing ten seconds of real time. (The alternating moves of the two sides actually overlap with one another rather than occupying the same time period, but it is easier to think in terms of distinct rounds.) Each round proceeds through three phases:

1 interceptor phase
2 bomber phase
3 escort phase.

In each phase, all units of that type that are still present on the map are activated in strict ascending order of their identification letters (from A to K). Each activated unit then completes four successive steps before the next unit is activated:

1 altitude change
2 movement
3 airspeed adjustment
4 firing.

After every third round, the bombers will have moved onto the forward panel, and the rear panel is shifted forward as described in Section 2. A die is used to record how many times this map rotation occurs, and after six rotations (eighteen rounds, or three minutes of action), the game ends and victory is determined.

ALTITUDE CHANGE

Bombers always maintain their initial altitude throughout the game. During their altitude change step, activated fighter units may either stay at the same altitude, climb one altitude level, or dive one altitude level. Fighters that climb have their counter replaced immediately by their next larger counter, showing an airspeed one lower than they had before. They then use this lower airspeed for the rest of the phase. If their initial airspeed is only two, they are unable to climb this round. Fighters that dive keep their current counter until the end of the airspeed adjustment step, at which point it is replaced by the next smaller counter showing the new airspeed calculated during that step. However, although their speed remains unchanged during the movement step, they are already considered to be at their new lower altitude throughout that step; the delay in replacing the counter is purely for convenience. Fighters that climb while in the top altitude band or while in the bottom altitude band are treated as having left the map.

MOVEMENT

Bombers automatically move two hexes straight forward each round, without making any turns. Fighters, after making any desired altitude change, move as many hexes forward as their current airspeed. After entering each hex, the unit may turn 60° right or left if desired. However, due to G forces, units must move at least two hexes straight forward before every even-numbered turn they make that round if they climb or fly level and have an airspeed of four, or before every turn they make at an airspeed of five or if they dive at an airspeed of four. Heavy fighters must move at least two hexes straight forward before every even-numbered turn they make that round at an airspeed of three, or before every turn they make at an airspeed of four or five. Hence, a normal fighter unit flying level at an airspeed of four could move one hex forward and turn, move a further two hexes forward and turn, and then move its final hex forward and turn, while a unit with an airspeed of five or that dives at an airspeed of four could make only two turns that round because of the need to move at least two hexes forward before each turn. The exception is that units may always weave by turning in the opposite direction to the turn they made in their preceding hex that round. Hence, a normal fighter unit flying level at an airspeed of four could move one hex forward and turn left, move one more hex and turn right (but not left), move one more hex and turn right again (an odd-numbered turn), and move one more hex and turn left (but not right).

Units that enter an unplayable hex at any point during their move are removed and treated as having left the map. Units may freely pass through or end their move in occupied hexes, except that units that end their move in the same hex and at the same altitude as other friendly bombers or fighters that have already moved that round suffer one hit and are immediately removed and treated as having left the map. This means that each side may have only one unit in each altitude level of each hex at the end of each round. If an unspent fighter unit encounters an enemy fighter (not bomber) unit at the same altitude in its penultimate hex of movement, then the moving unit may choose to stop its movement at that point (after any turn), rather than being forced to

move one final hex and so lose the chance of firing. However, in this case, the moving unit is required to throttle back and use an engine thrust of zero during the airspeed adjustment step.

AIRSPEED ADJUSTMENT

Bombers always maintain an airspeed of two throughout the game. Fighter units must roll a die during their airspeed adjustment step, adding three for engine thrust if desired, and deducting their current airspeed and the number of turns they made this round. If the unit climbed or flew level, it gains one point of speed if the result is 7 or more, and loses one point of speed if the result is −1 or below. If the unit dived, it gains one point of speed if the result is 0 or above. Hence, a unit that made two turns at an airspeed of four would accelerate to an airspeed of five if it rolled 3, 4, 5 or 6 when diving, and would decelerate to an airspeed of three if it rolled 1 or 2 when climbing or flying level. Heavy fighters whose current airspeed is three or more must roll two dice and use the lower score, so they are more likely to lose energy when flying fast or turning tightly but their ability to gain energy or turn at speed two is unaffected. Often, there is no need to dice, since the outcome is automatic. If using full engine thrust, this is the case for units with an airspeed of three or four that make no turns, units with an airspeed of three that make just one turn, and units with an airspeed of two that dive or make any turns. Airspeed may never fall below two or rise above five, whatever the result.

FIRING

Bombers or unspent fighter units that end their activation in a hex containing an enemy unit at the same altitude automatically fire on that enemy unit. The enemy unit automatically fires back simultaneously if it is a bomber unit in any orientation or if it is an unspent fighter unit whose heading differs by 180° (creating a head-on pass). Hence, a good way for interceptors to attack bombers head on is to end their move two hexes ahead and let the combat take place during the bombers' own activation – this has the merit that there is no firing penalty for any turns the interceptors made in their own move, and that the escorts cannot attack the interceptors this round because the bombers will be in the way. When an activated normal fighter unit fires on enemies other than US heavy bombers, it has its other counter of the same size placed temporarily beneath the existing counter until the unit's next activation, as a reminder that it has highlighted its presence and allegiance and also become more exposed to counterattack while it focuses on its own targets. (The exception against US heavy bombers reflects the double-edged nature of their defensive firepower, which made it dangerous for escorts to come too close.)

Firing in each combat is resolved by a single common die roll that is used by both sides in that combat, and is adjusted for each side according to these cumulative modifiers:

+2 if firing on bombers.
+1 for bombers firing on fighters whose heading is within 60°.
+1 for fighters firing on targets that have exactly the same heading (except for normal fighters attacking heavy bombers).
+1 for fighters firing on fighters whose heading is within 60° and that are exposed to attack (shown by having two stacked counters on the map).
+1 for activated fighters that dived this round and are facing directly down sun.
−1 for fighters firing on targets whose heading differs by 120°.
−1 for activated fighters that made three or four turns this round, or which made any turns and are engaging bombers whose

heading differs by 180°.
−1 for activated fighters that climbed this round and are facing directly up sun.
−1 for activated fighters that started the current phase in the same hex and at the same altitude as enemy bombers or unspent fighters.

If either side achieves a modified result of 5 or below, its fire has no effect. Modified results of 6 or 7 mean that one hit is inflicted on the enemy, while modified results of 8 or more mean that two hits are inflicted on the enemy. Each hit represents around one aircraft being shot down or two or three being damaged, but this may vary greatly depending on the number of aircraft in each unit and the resilience and value of the aircraft and aircrew concerned (losses of aces or of heavy bombers being more serious but harder to inflict). Fighter units become spent if they suffer a hit (causing the demoralisation of the remaining pilots), or if they fire and the unmodified die roll is 6 (reflecting the exhaustion of their ammunition). Bomber units never run out of ammunition and suffer no in-game effects, however many hits they suffer. The hits inflicted by each side are tallied separately for use in determining victory.

VICTORY

The game ends after eighteen rounds, or as soon as all interceptor units have left the map. Each side then scores one victory point for every hit it has inflicted, and the escorting side scores as many points as were agreed at the outset as the handicap total for that scenario. The side with more points wins, with the difference reflecting the decisiveness of the victory. It is also possible for players to keep individual totals of the hits inflicted and suffered by their own unit or units, so as to gauge their relative performance compared to other players.

INITIAL SETUP

Unlike in the other simulations in this book, players and game organisers are given great discretion as to the specific scenario they wish to explore. The number of bomber, escort and interceptor units, the type of bombers and fighters, and the initial altitude and airspeed of the aircraft, may all be selected as desired. Gross asymmetries between the number of escort and interceptor units should, as far as possible, be avoided, with differences in representational ratio within the units being used instead to balance the odds. The bombers should begin facing forwards in some or all of the three hexes shown in Figure 11.8 at altitude level two, unless there are three US heavy bomber units, in which case the unit furthest down sun should begin at altitude level three instead. Escort fighters should begin facing forwards at altitude level three at an airspeed of two, unless they are weaving at higher speed (as described in Chapter 10), in which case they all have an airspeed of three. Interceptors should begin with a maximum combined airspeed and altitude level ranging from three (representing units struggling up from below to reach the bombers) to nine (representing units swooping down from a much higher altitude).

Once all of these parameters have been agreed and the sun direction has been determined, but before either side's fighters are actually deployed, the game organiser may set a handicap level or the two overall commanders may make successive bids for one as in an open auction. The bidding starts at one and each commander may raise his or her bid by one at a time if desired. The higher bidder (or either commander at random if the final bids are equal), commands the interceptors, while the other player or team commands the escorts and gains as many handicap points as the higher bid. The escorts are then deployed in alphabetical order in any hexes within five hexes of a bomber unit, as long as there is only one unit at each altitude level in a given hex. Some escort units may be deployed at altitude level two, and for every one so deployed, one escort unit may be deployed later at altitude level four rather than at level three as usual.

Once the escorts have been deployed, the game begins with round one. The first interceptor phase sees the interceptors all being deployed on a common board edge as determined by a die roll. On a score of 1, 2 or 3, they all appear on the forward board edge (including in hexes adjacent to unplayable half hexes) in a facing directly opposite to that of the bombers. On a score of 4, they all appear on the board edge to the left of the bombers. On a score of 5, they all appear on the board edge to the right of the bombers and, on a score of 6, they all appear on whichever of the left or right board edges is up sun from the bombers. Interceptors starting on the left or right board edges may face any on-map hex not itself on any board edge, so most units will have a choice of two possible headings.

Interceptors are deployed in alphabetical order and on the first round they are simply placed in a selected board edge hex at any desired altitude and airspeed (variable for each unit) as long as no other interceptors occupy that hex at the same altitude and the total altitude and airspeed of each unit does not breach the agreed threshold. Some interceptors may begin at less than the agreed total of altitude and airspeed, and energy sacrificed in this way may be used to increase the total airspeed and altitude of interceptors deployed later, as long as the average combined airspeed and altitude of interceptors deployed up to this point does not exceed the agreed maximum. (Hence, if the set energy limit is six, one unit could deploy at level one at speed two, allowing the next two units to deploy at level four at speed three and at level three at speed five.) Deployment is the only action that interceptors take on round one, and they do not move or change their altitude or airspeed that round. When all the interceptors have been deployed, a die is rolled for each escort unit with an airspeed of three, to determine which way it is facing in its weaving course when the attack occurs. On a roll of 1 or 2, the unit is turned 60° to the left, while on a roll of 5 or 6, the unit is turned 60° to the right. Play now continues normally with the bomber and escort phases of round one.

EXAMPLE OF PLAY

Two players decide to simulate a German interception of a full combat wing of around 54 USAAF B-17 heavy bombers, such as might have occurred during Big Week in early 1944. Because of their phased escort tactics, the Americans are given just one squadron of around sixteen P-47 fighters to guard this part of the bomber stream, but in view of their small numbers and the highly experienced nature of their pilots, these fighters are represented at the lowest ratio of four aircraft per unit, making four escort units in all. The Germans are given two depleted *Gruppen* of Me110 'destroyers' accompanied by three fuller strength squadrons of Me109s and FW190s, amounting in all to over 50 aircraft, but to reflect their relatively larger numbers and their less experienced pilots, they are represented by just five interceptor units. The escorts will weave at an airspeed of three, while the interceptors are given a lower average energy level of five to reflect delays in getting such a large formation up to the high altitude used by the bombers. The sun direction is determined by assigning a roll of 1 to a position directly ahead of the bombers and the rest at 60° intervals clockwise. An initial roll of 4 is rejected as unacceptable, and the following roll of 5 means that the sun will shine from the rear left quarter of the bombers, suggesting they are flying home from the target in a northwesterly direction. The sun marker is placed in the rear left corner of the map, and the three bomber units are deployed with the rightmost one at level three.

The players now bid for command of the interceptors, taking into account the various elements of the tactical situation. The highest bid reaches three, so that player takes the Germans and his opponent starts off with three handicap victory points. The US player now deploys his escorts (letters A to D) in the hexes shown in Figure 11.8, with units A and B on either side of the bombers at level two so that units C and D can be placed behind and up sun of the bombers at level four, ready to dive down quickly to whichever quarter is threatened. All escorts face forward for the present.

Round one begins with a roll to decide the direction from which the interceptors appear. A score of 4 means that they are placed on the left-hand board edge, which happens to be the up sun position. Units F and G are chosen to represent the Me110s, as

indicated by having two stacked counters as a reminder of their vulnerability. They are deployed off to the side of the B-17s at level two and speed three, ready to curve in and exploit their ability to attack from directly behind without being as badly affected by the bombers' defensive firepower. Me109 units H and J are placed much further forward at level two and speed two, hoping to swing round for an initial head-on attack while also striving to increase their initially low energy levels. This energy sacrifice allows FW190 unit K to be deployed at level four and speed three to the left rear of the bombers, in a position both to deter the P-47 high cover from dropping down on the vulnerable Me110s and also perhaps to dive down out of the sun against the B-17s themselves. Each P-47 unit is now diced for to determine which direction it is currently flying in its weaving course, and on rolls of 3, 5, 1 and 4, units B and C are rotated right and left respectively to produce the initial situation shown in Figure 11.8.

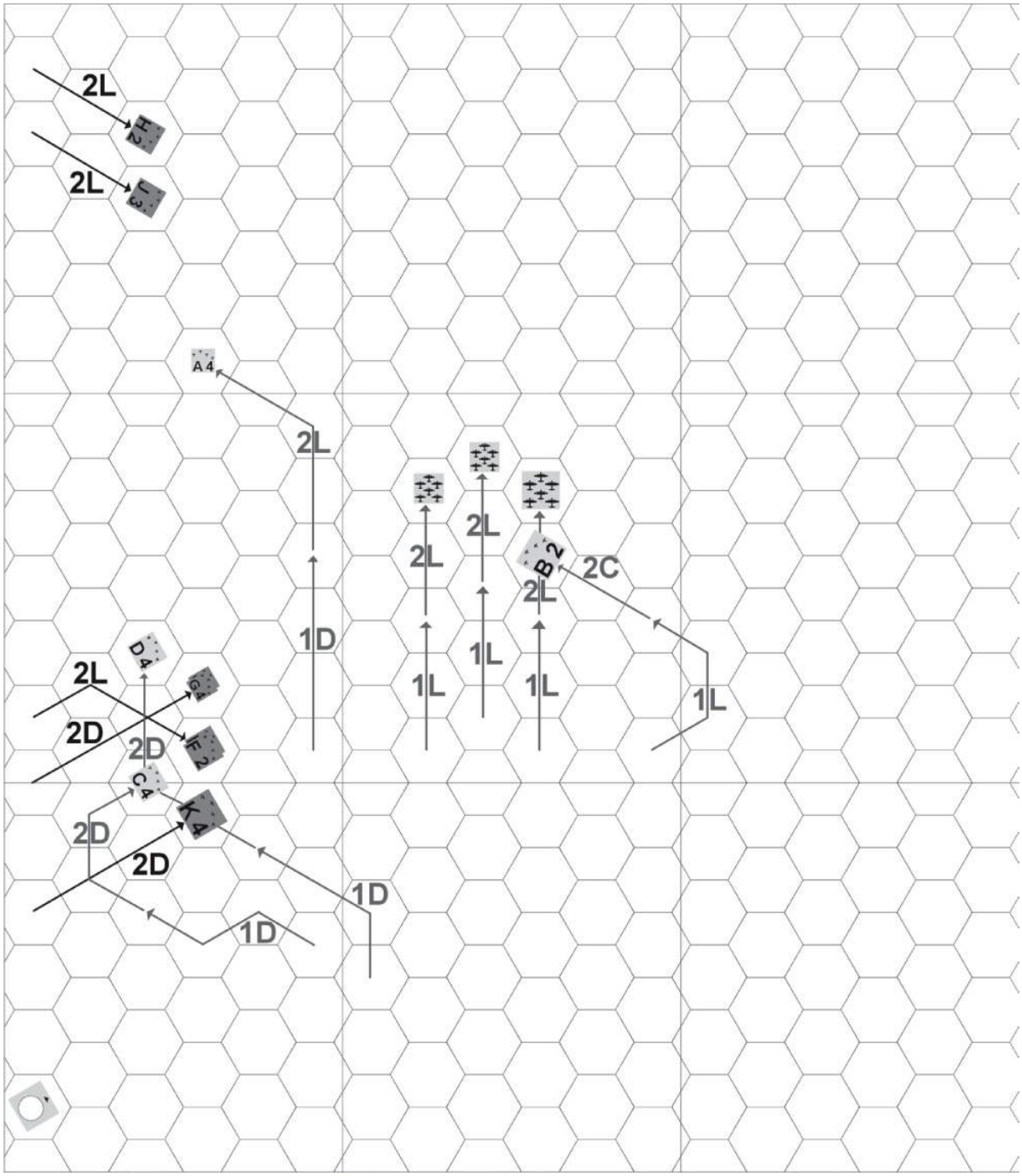
Round one continues with the bomber phase, during which all the bombers move two hexes straight forward. The escorts are now activated in order of their identification letters. Unit A wants to race ahead of the bombers to tackle the interceptors in front, so it dives to level one, then moves three hexes straight forward. It automatically accelerates to a speed of four, since even a roll of 1, when added to the three points of engine thrust, comfortably outweighs the current airspeed. Hence, the initial counter is replaced with the smaller one showing an airspeed of four at level one. Unit B is unfortunately facing away from the threat, so it maintains altitude and turns 60° left in each of the first two hexes of its three hex move so as to face back towards the bombers. This produces a net modifier of −2 (3 − 5) for the engine, the airspeed and the two turns, so on a die roll of 1 the unit would lose speed, but the roll is actually 3 so the unit ends its activation without having to flip its counter over. Unit C is well positioned to dive ready to swoop in behind the Me110s, but this would expose it to attack by the covering FW190s, so it dives and weaves left and then right in its first two hexes of movement so that unit K is left with only an unattractive head-on attack option. This time the die roll is only 1, so with another net modifier of −2 for the engine, the airspeed and the two turns, the unit does not gain any speed despite the dive, and all it needs is a smaller counter to show that it

is now at level three. Unit D is less immediately threatened by the FW190s, so it dives and then turns left in its first hex of movement, yielding a net modifier of −1 (3 −4) and so allowing automatic acceleration to a speed of four with no need for a die roll.

Round two now begins with the interceptor phase. Unit F could simply fly straight forward in pursuit of the bombers, but this might make it vulnerable to unit D, so it turns right in its first hex instead (an odd-numbered turn, so allowable for heavy fighters at speed three) and then weaves back left in its third hex of movement. Unfortunately, this yields another net modifier of −2, and as a heavy fighter unit at a speed of three or more, two die rolls are needed. The scores are 4 and 1, so the lower roll is used and means that the unit must flip over its counter and decelerate to speed two. Unit G takes a different approach and dives straight ahead to level one, thereby automatically increasing its speed to four and preventing the P-47s at level three from reaching it this round. Unit H far out in front flies two hexes straight forward and dices to try to accelerate based on its net modifier of +1 (3 − 2), but it fails on a roll of 3. However, unit J makes a similar move and gets lucky with a roll of 6, increasing its airspeed to three. Finally, the FW190s in unit K, with no immediate chance of getting behind either nearby P-47 unit, dive straight forward instead and automatically accelerate to an airspeed of four at the end of their activation, in order to catch the bombers.

Round two continues with the bombers moving another two hexes forward as usual. Escort unit A remains at level one, moving two hexes forward and turning left, then moving a final two hexes and turning right, in the hope of getting behind the Me109s. The modifier of −3 (3 − 6) brings a one in three chance of deceleration, but on a roll of 4 the unit retains its current speed. Unit B decides to climb straight ahead so as to stay behind the bombers and cover them against attack. Its airspeed falls to two before it moves, and the US player decides to throttle back so as not to risk accelerating and overhauling the bombers too quickly. P-47 unit C sees a chance to catch up next round with the slow moving Me110s in unit F, so it dives to level two, and turns 60° right in each of the first two of its first three hexes of movement, thereby ending up one hex directly behind unit F. The net modifier is −2 (3 − 5), so on a die roll of 3 the P-47s accelerate to a speed of four. Unit D

also dives to level two in pursuit of unit G. The G force restrictions on fighters diving at speed four mean that the unit must move two hexes forward before each turn, so it makes right turns half way through and again at the end of its movement, ending up to the left rear of unit G. The US player is worried about overshooting and so decides to throttle back; this produces a net modifier of −6 (0 − 6), so on a roll of 4 the unit maintains a speed of four despite the dive. The situation at the end of round two is shown in Figure 11.9, with the numbers on the unit paths indicating the rounds and the letters C, L or D showing whether the unit climbed, flew level or dived that round.



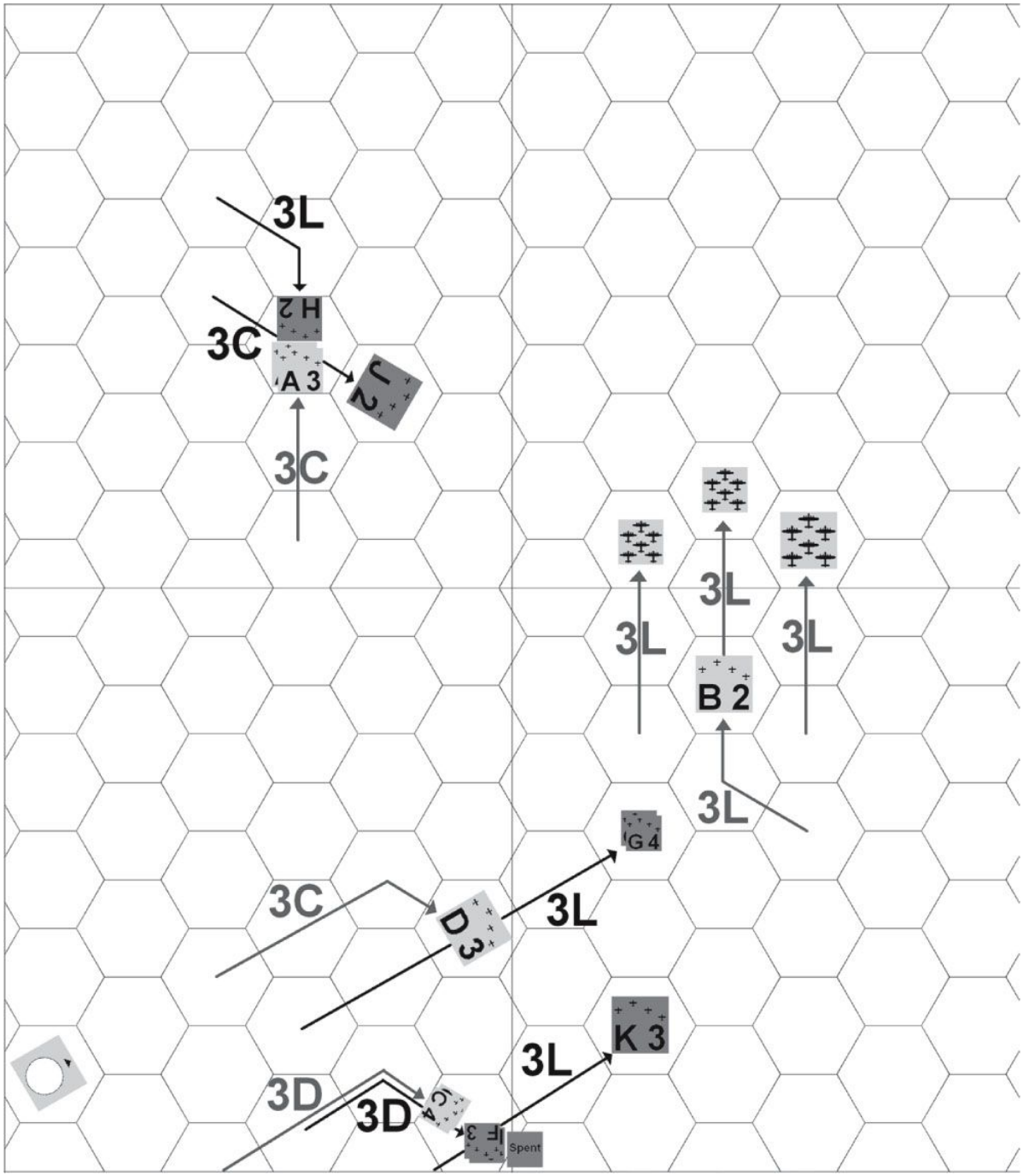
11.9 *Angels One Five* example 1

Round three begins with unit F's Me110s in deep trouble as the P-47s gain rapidly from behind. Unit F dives and conducts two hard right turns to try to escape the attack. The net modifier is −1 (3 − 4), so the unit automatically accelerates to speed three. Unit G, contrariwise, flies four hexes straight forward and turns left in its final hex so as to reach a position below and behind the left-hand bombers. The net modifier is −2 (3 − 5), but on rolls of 2 and 5 because of the heavy fighter penalty, the unit just manages to

maintain its airspeed. The Me109s in unit H will be vulnerable to unit A if they maintain their course, so instead they turn right in their first hex of movement to face the P-47s head on, thereby forfeiting any chance of acceleration this round because the modifier becomes 0 (3 − 3). Unit J takes a different approach and uses the speed it gained last round to climb to level three. This cuts the unit's current airspeed to two, but places it out of reach of unit A two levels below. The unit flies two hexes straight forward, but on a roll of 1 it does not get lucky and accelerate again. Unit K's FW190s move forward four hexes and turn left in their final hex, matching the move of the Me110s below to their left. They also throttle back, producing a net modifier of −5 (0 − 5) and just succeeding with a die roll of 4 in decelerating to speed three so that they may cover the Me110s once the altitude gap diminishes.

Round three continues with the bombers moving two hexes ahead. The P-47s in unit A decide to climb and fly straight forward to attack unit H's Me109s head on, since a mutual hit will prevent this German unit getting any net victory points in the game. The climb reduces the initial airspeed to three, but unit A still has to stop in its penultimate hex of movement in order to engage, so it must throttle back, yielding a net modifier of −3 (0 − 3). On a roll of 4, the unit is lucky and does not have to decelerate to a speed of two, which would have left it chronically short of energy for subsequent action. Because of the head-on attack, both units fire simultaneously, but no modifiers apply and so only a roll of 6 will bring a mutual hit; the actual common roll of 2 means the fighters flash past one another unscathed. Unit B flies level and moves two hexes, turning right in its first hex to reach the classic cover position above and behind the centre of the bomber formation, from which it can dive down next round to engage enemies attacking any of the three bomber units. Unit C is determined to catch the evading Me110s in unit F, so it dives after them to level one, moves the prescribed two hexes forward and turns right, and then enters and halts its move prematurely in unit F's hex. Unfortunately, G force restrictions leave the P-47s unable to turn again to get directly behind their opponents, so they must content themselves with a deflection shot. The statutory throttling back means that the net modifier is −5 (0 − 5), so with a die roll of 3 the airspeed remains at four. The combat modifier is +1 for the

continuing vulnerability of heavy fighters, and on a roll of 5 the Americans get lucky and inflict a hit on the Me110s, making them spent without the firers themselves running out of ammunition as they would have done on a roll of 6. The two US units that fired (A and C) both have their other similarly sized counters placed temporarily beneath their existing counters, to indicate that they will suffer from equivalent vulnerability if the Germans can get behind them next round. Unit D climbs back to level three, reducing its airspeed to three, and it weaves right and left in its final two hexes in order to threaten the FW190s in unit K. The modifier is −2 (3 −5), but a roll of 2 narrowly avoids further deceleration to an airspeed of two. Finally, the rear map panel is removed and positioned ahead of the bombers, producing the situation shown in Figure 11.10 (which focuses in on the four back left map segments where the action is now concentrated).



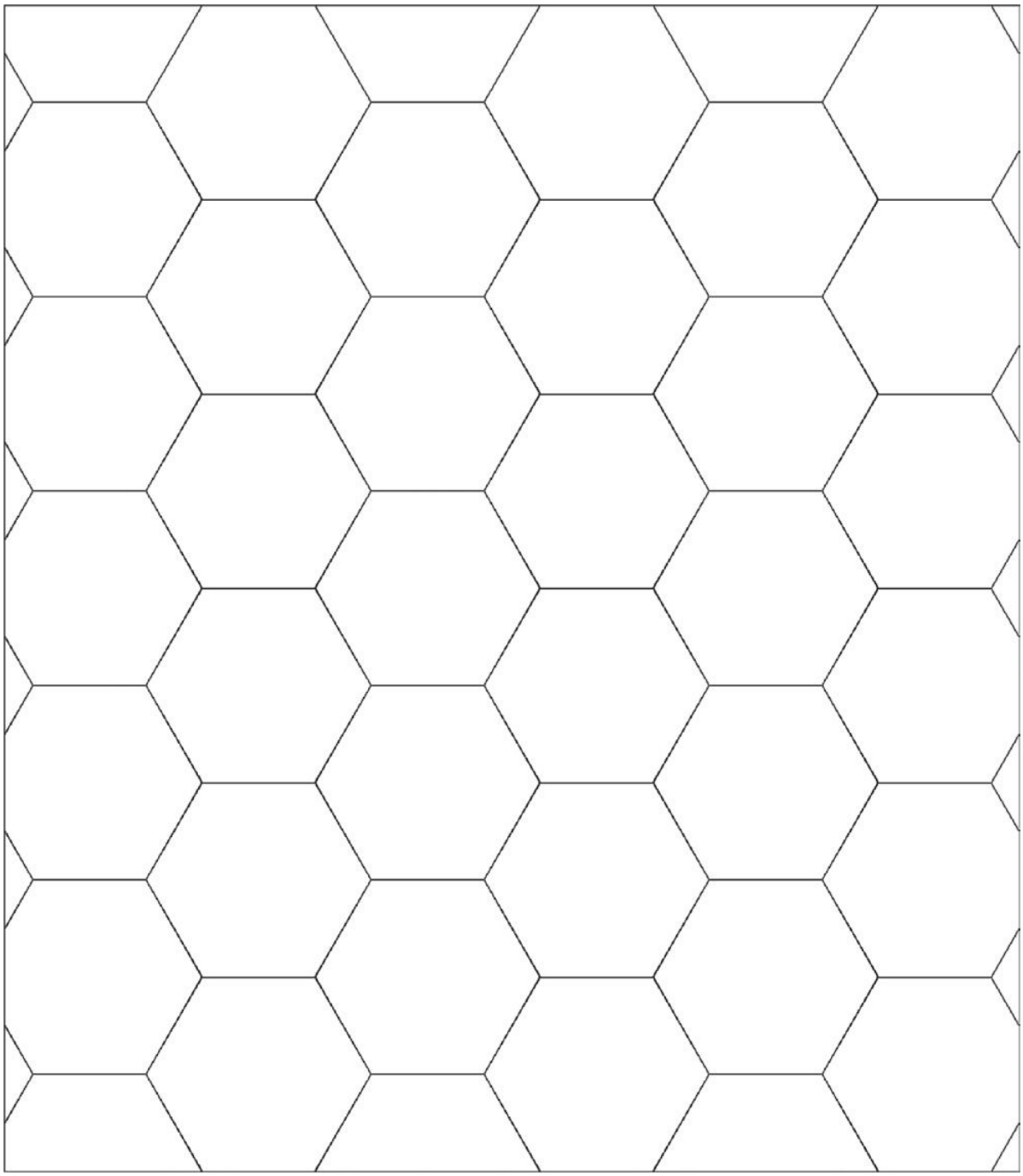
11.10 *Angels One Five* example 2

With three rounds gone, the German player's initial estimate of his chances is looking rather optimistic, since he has already lost one of his units and is one victory point down into the bargain. However, P-47 unit C was too eager in its pursuit, since the map rotation has left it facing an unplayable half hex, and so it will have to follow unit F off the board during its own next activation. The remaining Me110s in unit G are in position ready to climb up and attack the leftmost B-17s next round, but if they do so, the P-47s in

unit B will probably swoop down and engage them. Unit B in turn is vulnerable to the FW190s in unit K catching it up just as unit C did unit F, but this time there is a further US covering force in unit D that is poised to attack the FW190s if they do not make an evasive move instead. This illustrates beautifully the dynamics of successive covering forces that were such a key part of World War Two fighter tactics, analogous to the use of reserves on land. Further forward, unit A's prompt reaction has removed any hope of the Me109s being able to attack the bombers head on, but unit A is now out of position after its own abortive head-on pass, and unit J may be able to dive out of the sun against the B-17s on round five with unit H launching its own attack from behind and below on the following round. The outnumbered P-47s cannot be everywhere at once, and the Germans should soon manage to score some hits of their own.

The game illustrates well the inherently three-dimensional character of fighter tactics, with no fewer than thirteen of the 22 fighter moves in the contest so far involving significant climbs or dives rather than mere level flight. I am especially pleased to have found a simple way of capturing such dive and zoom tactics within the constraints of a two-dimensional medium. Another aspect that the simulation brings out well is the rapid loss of energy associated with tangled dogfighting, and the consequent tendency of fighters to drift downwards and to fall behind the inexorably advancing bombers. Even in just 30 seconds of action, the antagonists' average energy (airspeed plus altitude) has fallen from 5.0 to 4.8 for the interceptors and from 6.0 to 5.25 for the escorts, compared to a constant level of 4.33 for the bombers themselves. Starting off much higher than the bombers is a rather mixed blessing for the escorts, since it makes it difficult to dive down in time against lower attackers, and since the G forces produced by the high speed dive reduce manoeuvrability (as happened to unit D). That said, being low on energy is much worse, and one need only experiment with giving interceptors the minimum initial energy of three to see how vulnerable and impotent they are as they slowly claw their way up to reach the bombers. Overall, *Angels One Five* fills a crucial gap in the grand tactical modelling of aerial warfare, and casts light on a dimension that is not well covered either by computer simulations or by other manual games. Figure 11.11 provides the basic 6 x 6

hex map segment for you to photocopy and duplicate as described in Appendix 1, so that you may try out different scenarios and variants for yourselves.



11.11 *Angels One Five* map segment

Conclusion

While writing Chapter 11, I had the very encouraging experience of being commissioned by the Development, Concepts and Doctrine Centre (DCDC) of the UK's Defence Academy at Shrivenham to run an entire study day on manual wargaming, focused on exploring how techniques like those discussed in this book can be exploited more effectively by the British armed forces. I am writing this Conclusion just after running the study day, and the experience provides a very timely and appropriate lens through which to discuss the central message of the book as a whole.

The DCDC study day proved very popular and attracted over two dozen senior officers and analysts, half as many again as we had anticipated in our planning. Since most of them had no prior experience of this form of wargaming, I started off with an illustrated lecture to address the big picture and to correct the most common misperceptions. As in Chapter 1, I explained what wargaming is and how it relates to and combines other representational techniques such as mathematical modelling, operational research, game theory, role playing and verbal analysis. I then addressed the utility of wargames for education and research, as I do in Chapters 3 and 4. I stressed their role in providing synthetic experience of conflict mechanics and in facilitating logical analysis and dynamic experimentation (as in my previous book *Lost Battles*), but I subsumed all these within my main message that wargames are an ideal mechanism for active learning. This covers not only the process of transmitting insights from designer to players as they 'learn by doing', but also the way in which designers themselves learn through the iterative testing and tweaking process as their system comes to life and generates insights and questions that had not been anticipated beforehand. 'Active learning' hence encompasses a seamless web of both education and research. I finished the first half of my lecture by

discussing why manual wargames remain a very useful and important complement to the current emphasis on computerisation. As in Chapter 2, I outlined the advantages of manual games in terms of cost and convenience, their independence of technology (and hence much greater longevity), their continuing graphical merits compared to the fixed resolution of computer displays, and the salutary way in which they force designers to identify and highlight the key aspects of a conflict rather than trying to include every quantifiable element, as computer processing power tends to encourage. However, my main pitch in this area was on the much greater accessibility of manual wargames from a design perspective, a key topic to which I will return at the end.

I concluded my opening lecture by addressing three interrelated issues that are often seen as particularly problematic aspects of manual wargames, all of which involve difficult balancing acts in the face of inescapable trade-offs. The first is, of course, the fundamental tension between accuracy and simplicity, which I discussed in Chapter 2. I showed how this tension is not unique to wargames, since Lanchester's equations provide a wonderful example of flawed and simplistic assumptions while the more complex mathematics of Biddle and others are very hard for non-experts to grasp. I outlined the vital necessity for proper research and validation, the need to balance bottom up and top down modelling to avoid focusing too much on quantifiable technicalities and not enough on human inputs, and the dangers of seeing fine resolution as represented by more detailed maps and larger numbers of separate units as an indication that a wargame is necessarily more accurate overall than a simpler and quicker representation of the same conflict.[1]

The second issue that I discussed is the fog of war, which military wargames usually simulate directly by having several umpires and confining the opposing players to separate rooms. As in Chapter 7, I showed how the hobby alternative of gathering the antagonists around a single common map is not only cheaper and more convenient but can actually be preferable if the object is to give players and designers a clear overview of the dynamics of a particular contest rather than a more blinkered and confused

direct simulation of the viewpoint of an individual commander. Simple abstractions such as the sequence of play can often indirectly simulate the practical effects of the fog of war almost as well as using secret planning processes. Finally, I addressed the vexed issue of the 'luck of the dice', and I argued as in Chapter 8 that omitting such unpredictability would make wargames grossly unrealistic, while trying to model every possible source of Clausewitzian friction directly rather than through simple abstract randomisation would make the games so complex as to be completely unplayable. I used the graphs in Figure 4.1 to show how the width, locus and shape of the probability curves produced by multiple plays of a wargame not only reflect key design choices but also demonstrate that wargames are living systems that can generate new questions and insights through the unpredictable interaction of chance and the varying decisions of the competing players.

By far the best way to understand wargames is to play them rather than discussing abstract design theory, so we spent less than an hour on the lecture I have just outlined, and devoted the rest of the DCDC study day to hands-on experimentation. Beforehand, I had laid out the maps and counters for seven of my own designs as used in class, together with some of the simulations produced by my MA students over the years and a few commercial wargames to give a sense of their greater detail and complexity. After spending half an hour talking about and browsing through these various examples, we cleared them away and got on with the first illustrative game of the day. I had chosen to begin with the *Second Punic War* game from Chapter 9, since although its ancient setting is a world away from the contemporary preoccupations of the officers concerned, it is a fairly well-known and strategically fascinating contest, and the focus on factional role playing and negotiation chimes very well with the similar factional dynamics underlying recent conflicts such as those in Iraq and Afghanistan. The rules are simple enough that the participants had been able to absorb them from the pre-reading, and the game required only some faction name badges and a rough-and-ready map drawn on a white board, showing just how 'cheap and cheerful' manual wargaming can be. Even with the key

factions being doubled up, some participants had to observe the game because of the unexpectedly high attendance, but they still found it very instructive and worthwhile.

The Barcid and Phoenician players conducted a persistent offensive strategy, and combined with effective diplomacy this put the Romans on the back foot and meant that they were defeated after ten years of bitter fighting, just before Scipio could intervene effectively to turn the tide.[2]

After lunch, we moved from grand strategy and faction politics to more contemporary tactical gaming, so as to illustrate the enormous range of topics that wargames can encompass. I ran one game of *Fire and Movement* from Chapter 11, while another such contest was run simultaneously by my main teaching assistant Arrigo Velicogna, whose own project from my MA option was published recently, and who has other wargame publications in train and is currently completing his PhD in the War Studies Department.[3] This was the first time that *Fire and Movement* had been played outside the testing environment, so having seven professionals per game including senior officers with actual command experience in such battles was a real baptism of fire. The game acquitted itself well, and both contests were concluded within the two-hour slot we had programmed. The rules are slightly more complex than for the *Second Punic War* simulation, including as they do provision for such aspects as ammunition depletion and supporting mortar and machine gun fire, so the participants needed somewhat more initial guidance on mechanics and on tactical nuances. However, they soon got the hang of things, and the contests proved gratifyingly balanced, with both sides suffering significant losses and with the British winning one game by nine points to five and losing the other by four points to seven.

The real triumph of the study day was the game I had not originally intended to play at all, and which very nearly did not even exist. When DCDC first approached me to discuss running such a study day, it was clear that a major current preoccupation is the modelling of urban warfare, understandably in view of recent experience in Basra, Misrata and elsewhere. This inspired me to spend a few days developing *Block Busting* as a tweaked

variant of *Fire and Movement* (which is why Chapter 11 grew into the longest chapter in the book). I had originally intended only to append the *Block Busting* section to the pre-reading for the study day as something the participants could try out in their own time, but when it became clear at the last minute that attendance would be so much higher than expected, the project officer for the day suggested that he himself run a third game of *Block Busting* alongside the other two afternoon games. Fortunately, he is himself a hobby wargamer, and so not only was he able to do this without the usual training session but he was actually able to finish two complete eighteen-turn contests with his six players in the two hours that Arrigo and I spent running our single twelve-turn games of *Fire and Movement*. There could be no better illustration of the merits of simplicity in wargame design. Brigadier Andrew Sharpe, who masterminded the study day, was deeply impressed with the tactical realism of *Block Busting*, despite its relative simplicity, and he emphasised during the closing discussion session how well it captured the key dynamics of fighting in built-up areas.

I concluded my opening lecture at the DCDC study day with three overall points about manual conflict simulations, and these three points provide an equally good way of closing this book. The first point is that **manual wargames can be simple, cheap and quick**. As I explained in Chapter 2, most commercially published manual wargames contain detailed maps, hundreds of counters and tens of pages of complex rules, and each game takes several hours to learn and set up and several more hours to play. Although this helps to justify the high cost of these games compared to less specialist boardgames, it is easy to see why most people now prefer computerised representations of warfare with their automatic calculations, vivid 3D imagery and ‘pick up and play’ character. A key aim of this book has been to show that manual wargames can be as simple, cheap and quick as classic abstract boardgames such as chess, as long as one restricts them to the same kind of physical constraints – a few dozen pieces, a playing board divided into a few dozen zones, and a few pages of simple rules that the players can understand and memorise, allowing them to focus instead on the subtle tactics needed to

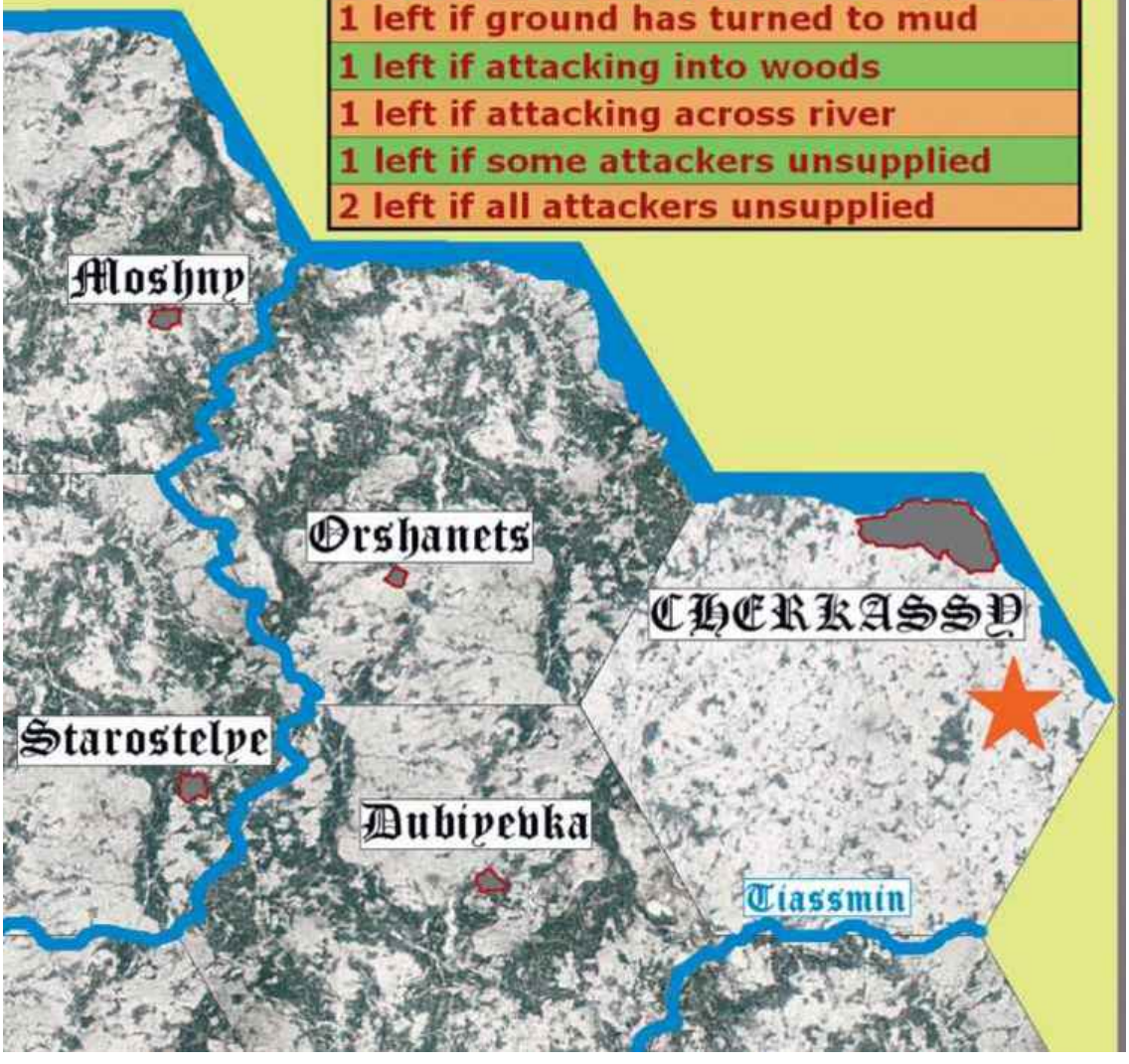
defeat an active opponent. The experience that I have just described with *Block Busting* illustrates how much of a difference simplicity makes, and this must surely be a key component if manual conflict simulation is to retain wider interest and utility beyond a dwindling body of specialist board wargame enthusiasts.

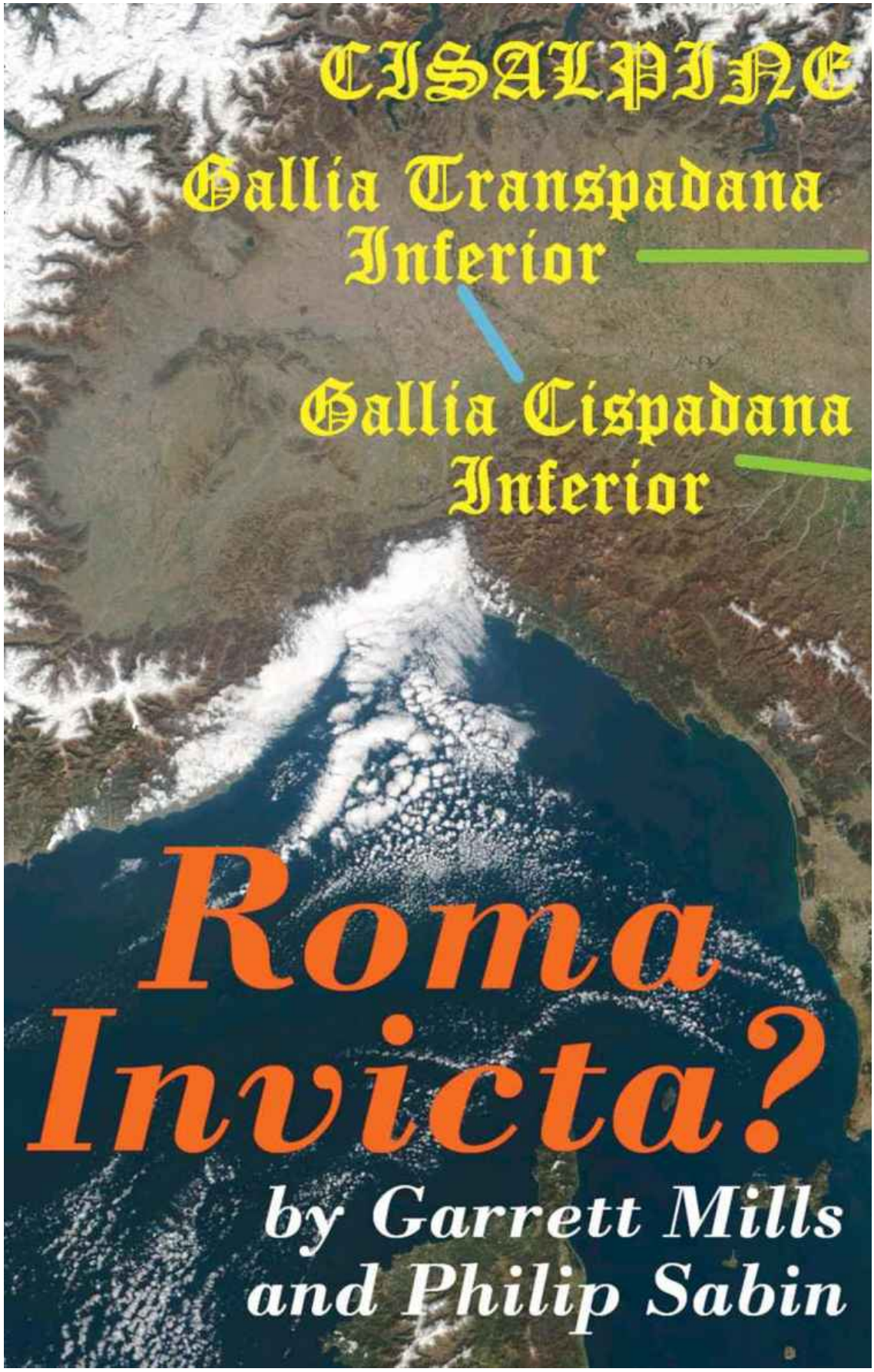
My second key point is that **even simple manual wargames can effectively simulate selected aspects of real conflicts**. This desire for simulation is, of course, a major burden for wargames to bear compared to entirely abstract boardgames such as draughts or chess, since real conflict is an enormously complex phenomenon and any attempt to capture its dynamics within a playable microgame risks oversimplification and the generation of artificial and misleading lessons. However, as I have shown throughout Part III, as long as one undertakes thorough research and uses an artful and appropriate blend of abstraction and direct and indirect simulation, even highly complex conflicts such as the tangled politico-military interactions of Hannibal's campaigns or the fast moving three-dimensional manoeuvres of dozens of aircraft during World War Two dogfights can be captured in simple but instructive manual games taking two hours or under to play. It is easiest to square the circle with games that simulate historical conflicts, since knowledge of how at least one actual contest developed allows one to base the design on observed outputs rather than just theoretical inputs, and since testing can be used to tweak initial ideas until the game system conforms better to historical precedent. Games on potential future conflicts are harder to validate and their assumptions are much more open to challenge, but at least in simple manual wargames the assumptions are explicit for all to see and there is much more scope to debate them and to experiment by replaying the game using alternative ideas. Since past and future are part of a single evolving continuum, modelling an array of previous and ongoing conflicts is, in any case, by far the best way of anticipating what conflict dynamics may be like in the immediate future, and manual wargaming offers a highly flexible and reactive tool that one may employ at short notice to model any conflict, based on the many thousands of simulations produced over the past 50 years on every kind of tactical or strategic engagement.

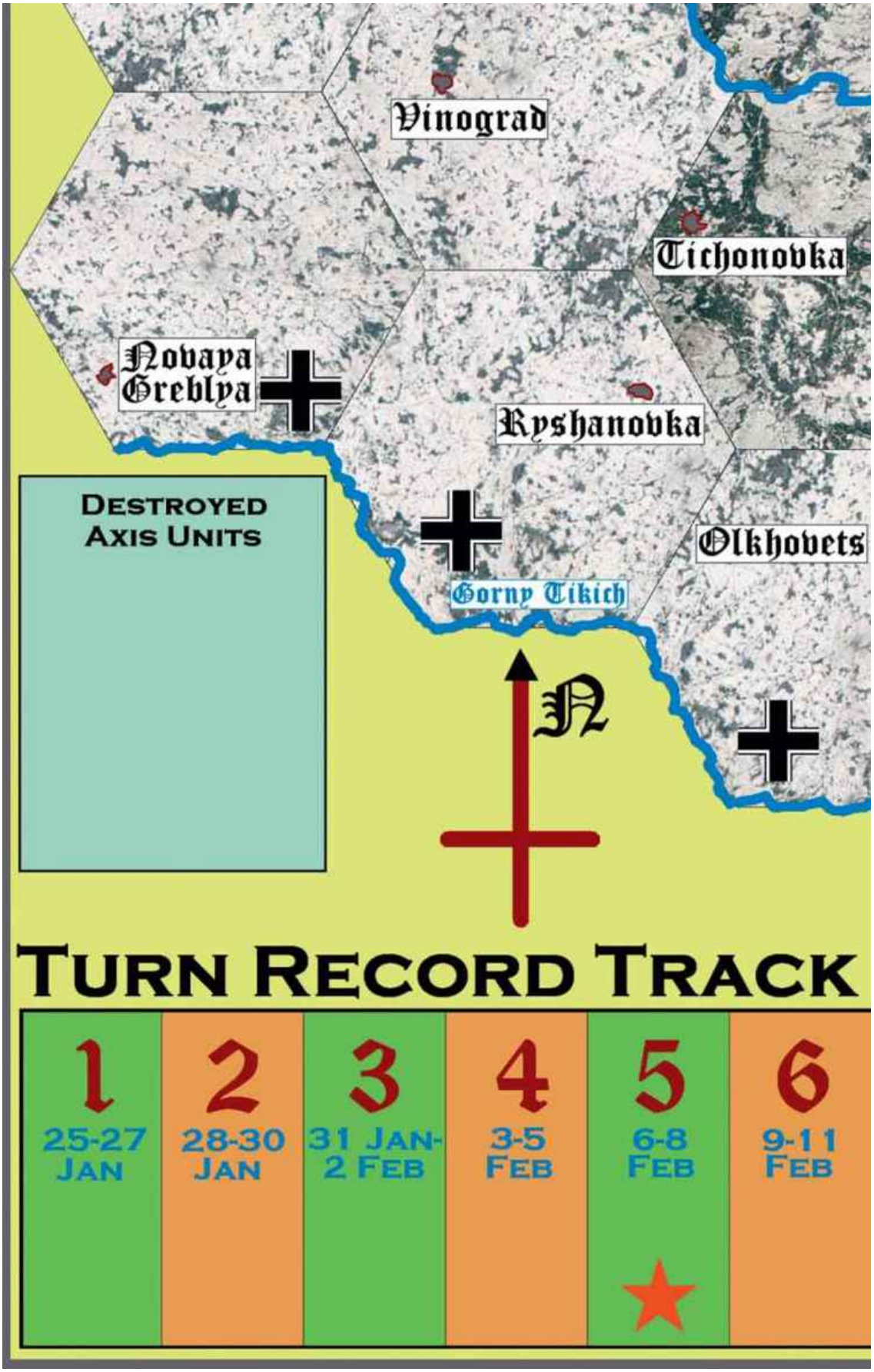
Combat Results Table

Die Roll	Attack Superiority							
	<1:1	1:1	3:2	2:1	3:1	4:1	6:1	8:1
1	0/0	0/0	0/0	0/0	0/0	0/1	0/1	1/2
2	0/0	0/0	0/0	0/0	0/1	0/1	1/2	1/2
3	0/0	0/0	0/0	0/1	0/1	1/2	1/2	1/2
4	0/0	0/0	0/1	0/1	1/2	1/2	1/2	1/2
5	0/0	0/1	0/1	1/2	1/2	1/2	1/2	2/3
6	0/1	0/1	1/2	1/2	1/2	1/2	2/3	2/3

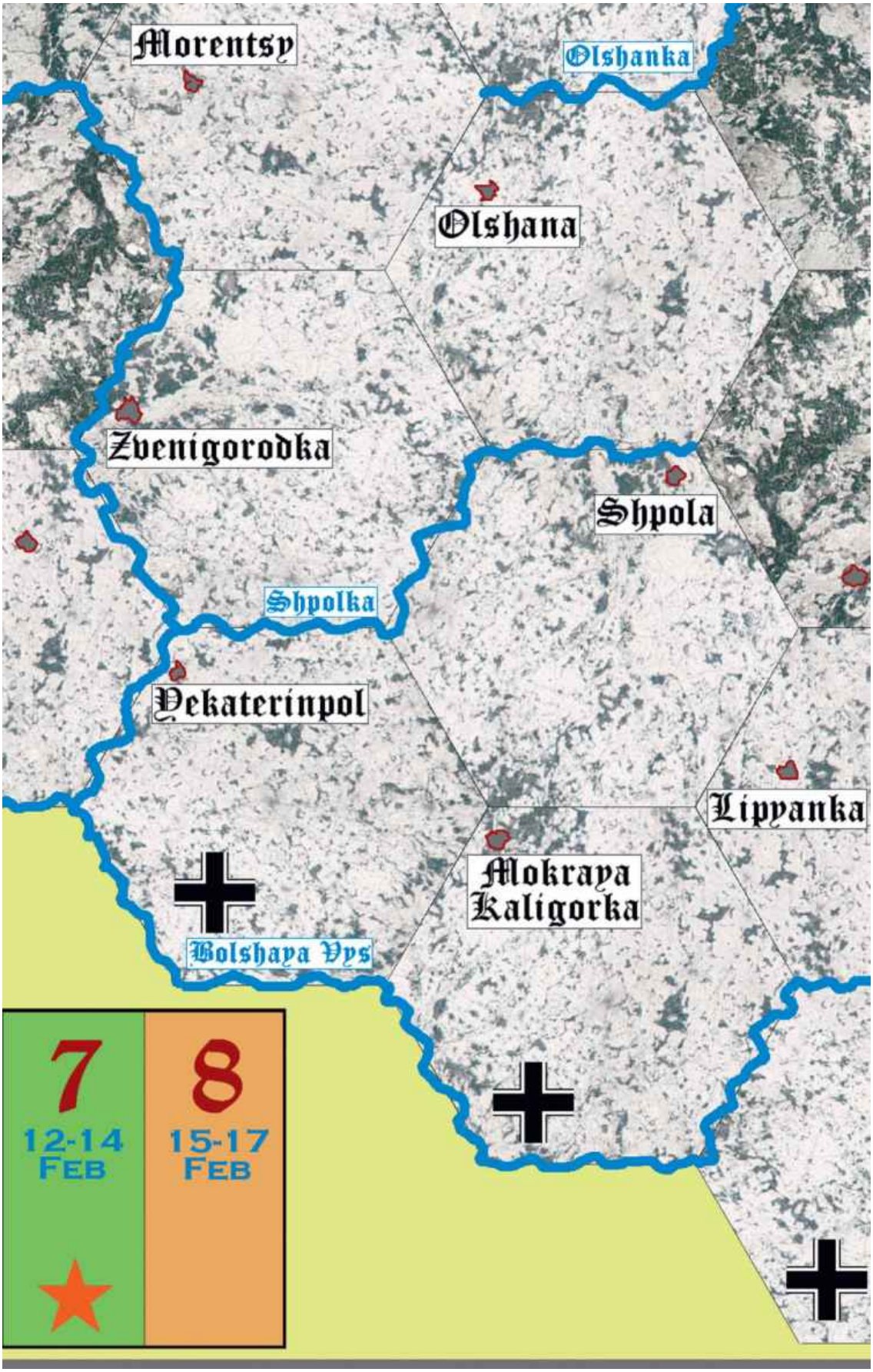
2 right if all defenders unsupplied
1 right if some defenders unsupplied
1 left if ground has turned to mud
1 left if attacking into woods
1 left if attacking across river
1 left if some attackers unsupplied
2 left if all attackers unsupplied

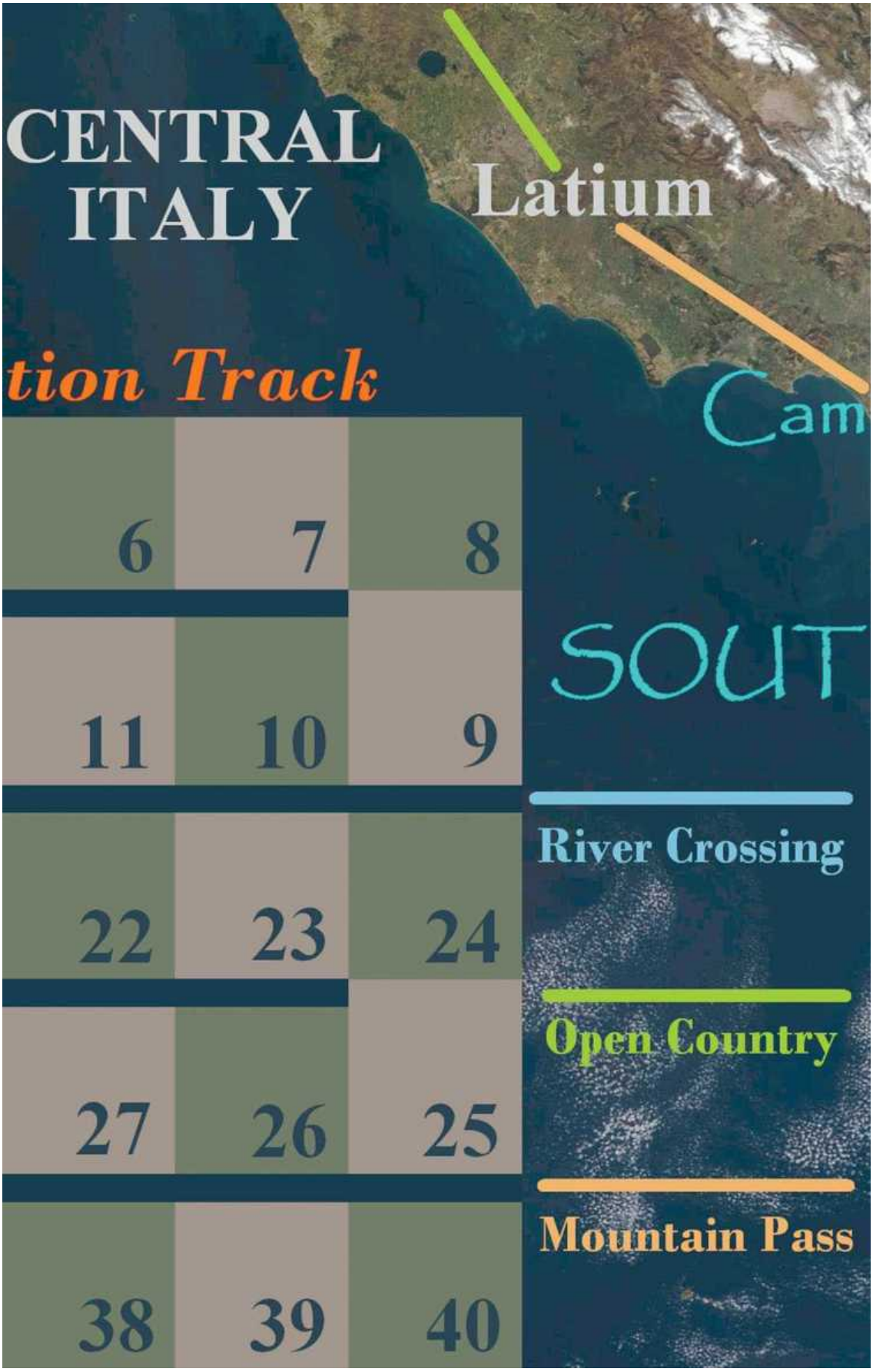


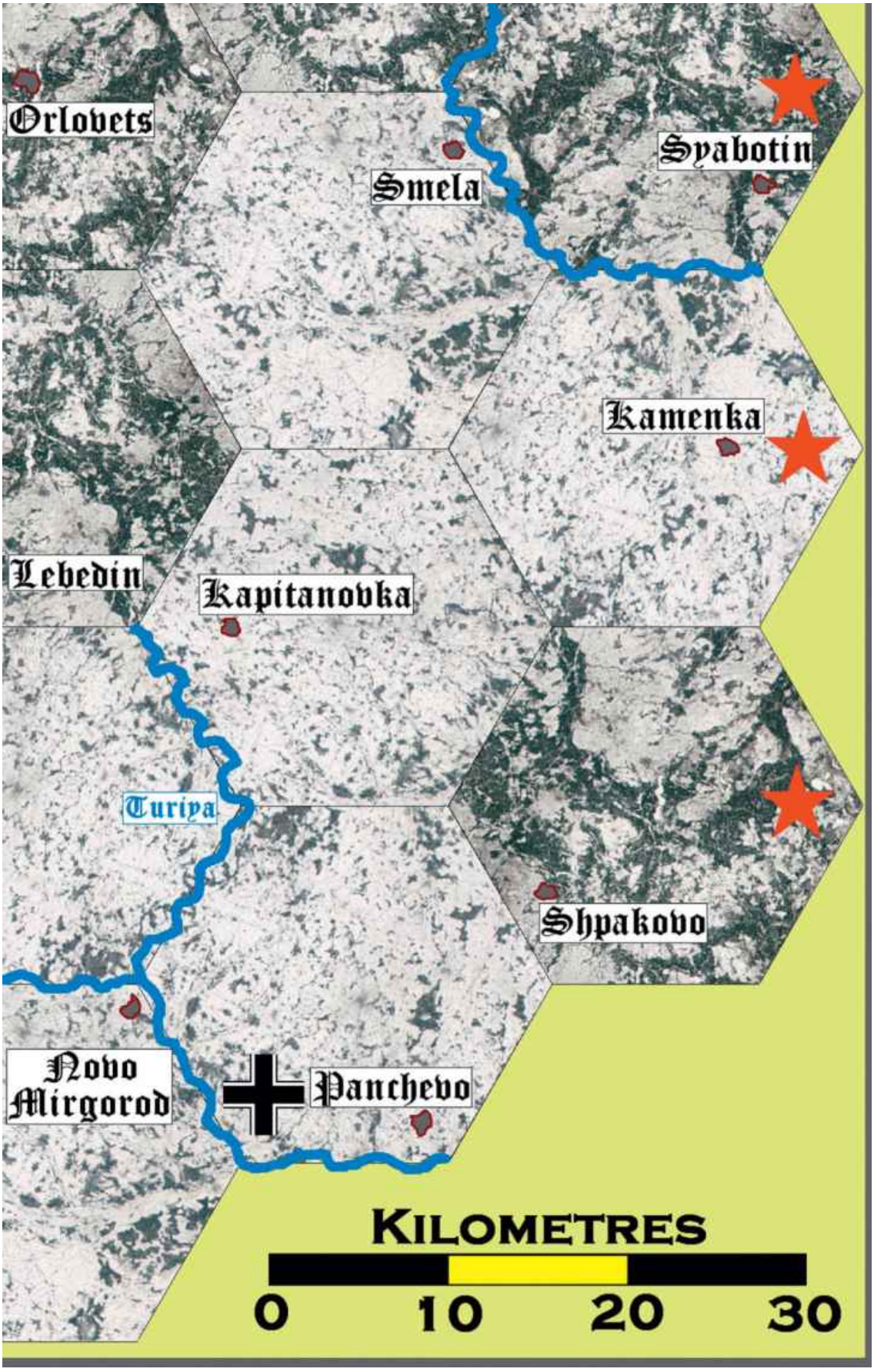

CISALPINE
Gallia Transpadana
Inferior
Gallia Cispadana
Inferior
Roma
Invicta?
by Garrett Mills
and Philip Sabin


Vinograd
Tichonovka
Novaya Greblya
Ryshanovka
Olkhovets
Gorny Tikich
DESTROYED AXIS UNITS
N
TURN RECORD TRACK
1
25-27 JAN
2
28-30 JAN
3
31 JAN-2 FEB
4
3-5 FEB
5
6-8 FEB
6
9-11 FEB

Samnium
pania
Apulia
HERN
ITALY
Lucania


Morentsy
Olshanka
Olshana
Zvenigorodka
Shpola
Shpolka
Yekaterinpol
Lipyanka
Mokraya Kaligorka
Bolshaya Vys
7
12-14 Feb
8
15-17 Feb


CENTRAL
ITALY
Latium
tion Track
Cam
SOUT
6 7 8
11 10 9
22 23 24
27 26 25
38 39 40
River Crossing
Open Country
Mountain Pass


Orlovets
Smela
Syabotin
Kamenka
Lebedin
Kapitanovka
Turiya
Shpakovo
Novo Mirgorod
Panchevo
KILOMETRES
0
10
20
30

Army Strength and Roman Demoralisa

0				
Cisalpine Gaul defects				
1	2	3	4	5
		Fabius appears		
16	15	14	13	12
				Southern Italy defects
17	18	19	20	Marcellus appears 21
32	31	30	29	28
33	34	35	36	37

This leads me into my third and final key point, namely that **manual wargames can be produced and tailored by non-experts to meet specific active learning requirements**. As my own experience and that of my MA students amply demonstrates, you do not need to be a mathematician, a computer programmer or a professional operational researcher to design an effective manual conflict simulation. As Perla correctly recognised, wargame design is much more of an art than a science, and what matters most is to be able to identify the key dynamics of a particular conflict and then to apply a judicious blend of the various modelling techniques devised over the past couple of centuries in order to capture those dynamics in a valid but playable simulation.[4] It certainly helps to have played wargames before and so to have an intuitive understanding of the techniques available, but this is by no means an essential requirement – experience over the years within my MA option shows that board- or computer wargame veterans tend to be too ambitious and try to cram in too much of the detail and subtlety from published commercial games, whereas neophytes are often better at abstraction and at boiling conflicts down to their bare essentials. What really matters is to study and play other people's designs on the same or similar topics, to critique those designs based on thorough research into the real-world phenomena being simulated, and then to produce one's own simpler and quicker design that still captures the desired essentials of the contest concerned. Playtesting is absolutely crucial, and the iterative process of testing and tweaking throws up questions and insights that prompt further thought and research and so help the designers themselves to gain greater understanding of the conflicts they are trying to simulate. Whereas computer games have created a wide gulf between programmers and players, manual wargames are harder to play but easier to tweak or to redesign from scratch, a major benefit that is well summarised in Dunnigan's aphorism: 'If you can play them, you can design them.'[5]

Manual wargames do benefit hugely from the more general contribution of networked computing to modern life, especially in terms of the widespread availability of graphics software and the

potential for inexpensive online publicity, discussion and dissemination. This book is no exception and the book's website (http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/simwar.aspx) contains free downloads of the artwork needed to print out larger copies of the maps and counters or to play the simulations on the PC screen using the freeware programme *Cyberboard* (which is also great for designing one's own game components). I provide more details on all this in Appendices 1 and 4. If any significant errata arise for the simulations, I will post them on the website in due course. As with my previous book *Lost Battles*, I have also started a Yahoo! discussion group on simulating war, and I urge all readers to browse the postings at http://groups.yahoo.com/group/simulatingwar/ or to join the group and contribute for themselves. This group offers an ideal forum to seek clarifications on the simulation rules, or to share ideas on the use of wargames as an active learning tool. Group members can also post their own draft simulation designs for comment and feedback from other members, just as my MA students benefit from one another's ideas and playtesting input as they prepare their simulation projects. As I mentioned at the end of Chapter 4, our *Lost Battles* Yahoo! group has been phenomenally successful, and now contains well over twice as many words as there are in the book itself.[6] I hope that the simulating war group will build up into an equally valuable supplementary asset, and I look forward to seeing and responding to your contributions in the months and years ahead.

Unlike other conflict modelling techniques such as operational research and game theory, wargaming of various kinds has become a popular (if rather specialist) recreational activity over the past 50 years.[7] This has double-edged implications for its utility as a vehicle for active learning within defence and academia. On the one hand, the hobby has given rise to many thousands of published games and articles, and many teachers, analysts and military personnel are themselves recreational wargamers. On the other hand, sceptics often see gaming as a rather trivial and childish activity, and are reluctant to accept that it has anything serious to contribute alongside more traditional ways

of studying the complexities of warfare. This stigmatisation has helped to drive hobby wargamers ‘into the closet’, and has hindered the development of effective synergies between professional and recreational wargaming.[8] The growing prominence of computer simulations in the post-Cold War era has broken down the barriers significantly by making simulation into a mass market leisure activity as well as a core component of military training and an important teaching and research tool in academia. However, manual simulation has tended to be dismissed as outdated in the new computer age.[9] My own long experience of studying and using wargames, culminating in the recent DCDC study day, suggests that simple manual conflict simulations do, in fact, have significant continuing utility as vehicles for understanding conflict dynamics, and that they complement computer simulations in various important ways (especially their flexibility and design accessibility).[10] I hope that this book will go some way to deepen awareness of this extensive and neglected body of materials and techniques, and that others will be inspired to exploit the very significant active learning potential of wargames as I myself have come to do. If Clausewitz were alive today, I think that he would see wargaming as an even closer analogue than a game of cards to the conflict dynamics that he analysed with such insight two centuries ago.[11]

Appendix 1: Assembling the components

I explained in the Introduction that the physical differences between books and boardgames are a key reason why wargames so rarely appear in traditional bookshops and libraries. A major objective of the present work is to bridge this gap, and so bring manual wargames to the notice of readers who might otherwise scarcely realise they (still) exist. This requires some sacrifices in the quality of the physical components compared to dedicated board wargames with their large maps and sheets of card mounted die-cut counters which simply need to be punched out of the sheet in order to play. Even glueing folded maps into the back of this volume (as was quite common practice up to the mid-twentieth century) proved impractical given the way in which modern book publishing has been automated and streamlined to fit into a single standard format. However, the great benefit of fitting into this format is that production costs are much lower than for a professionally finished boardgame with all its various specialist components, as I know only too well from my recent experience publishing a deluxe boardgame edition of my previous *Lost Battles* book.[1] Even the hardback edition of this current book has a retail cost only around half that of a single modern board wargame, despite providing no fewer than eight fully playable simulations and 150,000 words of detailed analysis and references.

One way in which you may try out the various games (as long as you actually own the book!) is by using the physical components provided on the colour plates. If you wish to do this, the first step is to cut or pull out the twelve sheets of plates from their locations throughout the book. Before going any further, you then need to scan or photocopy the five sides of black and white illustrations on these sheets, which provide the maps, terrain pieces and counters for *Fire and Movement* and *Block Busting*

and the counters for *Angels One Five*. You may now carefully cut out the three panels of the *Big Week* map, and hinge them together using tape at the back to form a single eight by sixteen-inch playing surface. The six panels of the *Roma Invicta?* and *Hell's Gate* maps fit together in similar fashion in a 3 x 2 array to form a sixteen-inch square playing surface in each case, but here assembly is complicated by the fact that one map is on the reverse of the other. The best way forward is to lay out a sheet of transparent book covering film with the sticky side up, and then to place each panel carefully into position next to its neighbours so that they are joined up properly whichever map is in use.

You should now be left with three sheets of plates with the full colour counters for the three games just discussed. Cut out the two separate panels of counters for *Hell's Gate*, ensuring that they remain the same overall size. Spread a good all-purpose adhesive all over the back of one of the panels, and glue it in the corner of a sheet of medium thickness card (such as that at the back of writing pads). Cut the card carefully along the other two edges of the panel, and then spread adhesive on the back of the other counter panel and paste it to the reverse side of the card (making sure not to glue it upside down!). Press the completed counter panel beneath a book, and leave the glue briefly to dry. You can then carefully cut the counters into lateral strips.

Since game counters suffer constant handling that can soon cause them to fray or scuff, I prefer at this stage to cover each strip in transparent film, by sticking the counter strip onto a piece of film, cutting the film to leave substantial flaps at the top and bottom of the strip, and then wrapping these flaps around the strip so that they overlap across most of the back of each counter. Now you need only press the film into place and cut off each individual counter in turn from the strip, just as if chopping carrots! It is all too easy for counters to go astray, so I recommend storing them in one or more ziploc bags of the kind you can buy for keeping sandwiches fresh.

The single sheet of colour counters for *Roma Invicta?* and *Big Week* may be assembled using exactly the same techniques. The *Roma Invicta?* counters are only single sided and so are rather easier to produce, but the *Big Week* counters are double sided

and at the lowest practical limit for counter size, so you will need to build on your experience from constructing the other components and be as precise as possible in joining up the front and back panels and in cutting out the counters, especially given the importance of not obscuring the symbols recording fighter endurance and readiness. The whole process is fairly straightforward, and once you sit down with the book, a pair of scissors and some glue, card and covering film, it should take you only a couple of hours to have all three full-colour games assembled and ready to play. However, I strongly suggest that you practise by constructing one or more of the photocopied games first (while retaining a master copy), so that you don't make a mess of your only copy of the colour components.

The components for the three black and white games need to be scanned or photocopied at the outset not only because it is impossible to use both sides of a single sheet of plates for anything other than a double-sided map, but also because you will wish to expand the size of the components to more readily playable dimensions. The map, counters and terrain pieces for *Fire and Movement* are already on the same scale as one another, so you just need to expand them all by the same proportion. The *Block Busting* map is rather larger than it should be relative to the dual-purpose counters from *Fire and Movement*, so you will need to use a lower enlargement ratio for this so that the squares end up the same size as the blank squares at the bottom of the terrain and counter sheet. I recommend enlarging the *Fire and Movement* map to at least A3 size, but if you want something even bigger or you are limited to A4 sheets, you will need to copy only sections of the maps at a time and then either paste the overlapping sections together or cut and hinge them to form a larger whole. My own *Block Busting* and *Fire and Movement* maps have been expanded to stretch over no fewer than four and nine A3 sheets respectively, with the individual troop counters being over 2.5 inches across. (These counters are, of course, assembled using the same double-sided techniques as for *Hell's Gate* and *Big Week*.)

Although the printing may be in black and white, this does not mean that you need to use a white background for the maps and

counters themselves. Pastel shaded paper is easily and cheaply available, and looks much better. I had my own components for *Block Busting* and *Fire and Movement* printed on buff coloured 175 g/m^2 card, which makes them more durable as well as more attractive. *Angels One Five* positively requires you to use different coloured paper or card, since you will need to print out the double-sided counter panels twice to represent the two opposing forces, with the colour of the paper on which you print them being the only way of telling them apart. It is important that you assemble the four different sizes of counter separately, to make sure that the front and back are properly aligned. You will need to photocopy Figure 11.11 and print it out nine times (ideally on blue or green paper), before cutting out the nine segments and assembling them into the three identical 18 x 6 hex panels required to form the rolling map. You should expand each map segment and counter panel in *Angels One Five* at least to A4 size, making sure that the hexes are big enough to contain the largest counters as shown in Figure 11.8.

If you print your maps and terrain pieces onto paper rather than card, you can make them more durable by gluing them onto card and/or covering them in transparent film. Using a laminator may be an easier alternative, but laminated sheets may not respond well to trimming and are certainly far too thin for counters. I mount my own large counters on polystyrene foam board from a stationers, which makes them much easier to cut with a craft knife than is thick card, but this is probably going too far for counters smaller than an inch across.

You may well prefer not to remove the plates from the book itself, but rather to print out your own separate copies of the full colour games just as for the black and white ones. To do so, you can either make colour photocopies of the plates or download digital copies of the graphics files from the book's website at http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/simwar.aspx. Colour printing is obviously more expensive than black and white, but if you can afford it, you can expand the components to a much larger size, as with my own class copies of *Hell's Gate* as shown in the first colour plate. I get

a local print shop to produce my own game components, rather than constantly depleting my colour ink.

If you want to try the games without any effort at all to construct physical components, then you may download a different version of the graphics files from the website and display and manipulate them on your PC screen using the *Cyberboard* program described in Appendix 4. The simple games from Chapter 3 and Appendix 5 make even fewer demands in terms of components, and so even the most inexperienced or butter-fingered reader should be able to progress quickly to hands-on experimentation with the kinds of simulation techniques I have described.

Appendix 2: Finding published simulations

I have stressed throughout this work that an important stage in designing your own tailored simulations is to study existing published designs on the same or related topics, even though in themselves they will probably be too complex and time consuming to be employed directly. As I said in the Introduction, wargames are very unlikely to be found in bookshops or libraries, but the internet now makes searching for and obtaining them a much easier task than it was hitherto, although it does involve a certain amount of expense compared to the process of consulting more traditional sources in libraries or archives.

The first step is to identify what games have already been published on a particular topic over the past five decades. For board wargames, the best starting point for this is Alan Poulter's site at http://www.grognard.com/, which includes a very useful (though not comprehensive) listing of games by period and subject, broken down into several dozen categories such as 'World War I Eastern front'. The site often contains one or more short online reviews of the individual games, and once you have identified particular titles of interest, you can also run a search for them on the very comprehensive http://www.boardgamegeek.com/ to find further details including images of the map and counters. John Kranz's site at http://www.consimworld.com/ is an excellent place at which to find out about forthcoming and recently published board wargames, and if you click through to the 'Individual Game or Series Discussion' within the 'Boardgaming' section of the Forum, you will find comments on thousands of older games as well. For computer wargames, the equivalent site is http://www.wargamer.com/, but you will have to browse this more carefully and follow the links to individual computer wargame publishers to get a sense of what games are available on specific topics.

More detailed reviews of particular games are contained in specialist review magazines such as *Fire & Movement*, but unfortunately these are not well indexed online, and back issues are often harder to find than the games themselves. It is worth consulting Nicholas Palmer's two books to see capsule reviews of many of the early board wargames published in the 1960s and 1970s, and for around $60 you can now buy CD copies of the first 50 issues of *Paper Wars* magazine with several hundred more detailed reviews of games from the 1990s and before.[2] The latest board wargames are reviewed in the very impressive new magazine *Battles*, and if you read French, you will find further reviews of recent games (including some computer wargames) in the magazine *Vae Victis*.[3]

The simplest way of buying a specific boardgame is from one of the online dealers who not only sell the latest published games but also carry a large stock of used wargames from the past. The two leading such dealers are http://www.nobleknight.com/ in the USA and http://www.secondchancegames.com/ in the UK. If neither of them happens to have a particular game in stock, you will need to try other second-hand dealers such as http://www.bbwargames.co.uk/, or else look for the game on eBay, which always has hundreds of old board wargames for sale as people thin out their collections. Games that are still in print can be obtained direct from the publishers or from local retailers such as http://www.leisuregames.com/ in the UK. Used board wargames tend to hold their value much more than old computer software, but (as with second-hand books) there are now few important titles that are truly unobtainable as long as you are prepared to pay the going rate.

As an illustration of how this process can work, let us say that you want to find existing simulations of the battle of Hastings in 1066, to help you design a simple game on the subject for use in class. You look on the 'Medieval Europe' section of Poulter's periodised list, and find eight games of interest. One is a free online game on the BBC website, but it takes just two minutes to play so is too slight for your purposes.[4] Another recent simulation has the promising title *1066*, but you realise from the description that it is a strategic rather than a tactical game.[5] This leaves six

games on the battle itself, including one French game for which there is an English rules translation on the website and two games (*Age of Chivalry* and *William the Conqueror*) that model one or more other engagements besides Hastings. You check out the six games on the Boardgame Geek site, and find illustrations of all but the obscure *William at Hastings* from 1976. You also discover a few more Hastings games in the process of your search. Having gained a fairly good sense of what each game involves, you look to see which of them are available to buy. When I checked this as an exercise, I found that the main three games were available from both the US and UK dealers I mentioned (despite all being long out of print). The two multi-battle games were quite expensive, but the 1986 simulation by Richard Berg could be bought for only around $20.[6] I did not buy any of them, because I own them all (plus two of the others) already!

Appendix 3: Basic mathematics

As I said in Chapter 2, a major advantage of board wargames compared to computer games or more explicit mathematical modelling is that they can be designed without anything like the advanced programming or maths skills the other techniques require. However, since the basic system of a manual wargame is, in fact, a mathematical model (even though it is expressed mainly in words, as illustrated in Part III), there are some simple numerical principles that you will need to grasp, especially if you wish to design your own simple simulations. These principles are pretty elementary, and boil down largely to common sense, but I will lay them out here in as non-threatening and equation free a manner as possible, making extensive reference to the various game systems described in Part III to show how they apply in practice.

The most common numerical principle that you will use is proportionality. Consider first the *Big Week* simulation from Chapter 10. As I said, I wanted to build on Craig Taylor's very successful approach in his 1982 game *Bomber* of having the B-17s and B-24s fly two hexes per turn, while fighters cruise at three hexes per turn.[7] We know that the real bombers flew at around 180 miles per hour, and it makes sense to divide the game into half-hour turns. It follows from simple proportionality that, in half an hour, bombers would fly half as far as in a full hour, that is to say 180 divided by two, or 90 miles. If we want this to be reflected in the game by a two hex move each turn, then similar proportional logic suggests that the distance across a single hex should be half of 90, or 45 miles. Exactly the same techniques are used to relate the distance, speed and time scales in *Angels One Five* from Chapter 11. Here, the bomber speed is the same at 180 miles per hour, and the bomber units in the game again fly two hexes per turn, but now each hex represents just a quarter of a mile across (conventionally measured as the perpendicular distance between the centre of opposite hex faces). Since there are 60 minutes in an hour, a speed of 180 miles per hour corresponds to 180 divided by 60, or three miles per minute. At a quarter of a mile per hex, one mile is four hexes and so three miles is

twelve hexes. Bomber units in the game fly two hexes per turn, so it will take them twelve divided by two, or six turns to cover this twelve hex distance. Hence, six turns must represent one minute (60 seconds), so one turn represents 60 divided by six, or ten seconds of action. (You could use a similar process to work out how much space each hex represents at a chosen time scale, or to decide how many hexes the units should move at various speeds given any selected ground and time scales.)

I mentioned in Chapter 4 how depressingly common it is for published battle maps to contain dreadful errors of scale, so it is worth emphasising the use of proportionality in this case. A good technique is to measure in a reliable atlas or on Google Earth the distance between two cities or other distinctive features that will be on opposite sides of the game map (in the same direction as the hex grain as shown in Figure 5.1), and then to use the scale on that page to calculate the actual distance in the real world. For example, in one of my atlases, it is 5.7 inches from the coast at Dunkirk to Regensburg, on a page on which one inch represents 80 miles. This suggests that the actual distance between the cities is 5.7 times 80, or around 456 miles. Use of the marker and ruler tools on Google Earth gives a more precise distance of 454 miles. At a scale of 45 miles per hex in the *Big Week* game, this suggests that bombers over Dunkirk should have to fly for 454 divided by 45, or around ten hexes, to reach their primary target. As shown in Figure 10.1, this is exactly what I have arranged in the simulation (although the fact that the bombers enter the map over the English Channel rather than over Dunkirk itself means that they actually have to travel eleven hexes, taking them a crucial extra turn).

A second form of mathematical calculation that you will need to employ is the comparative weighing of numerical payoffs. I described in Chapter 8 how real-world achievements such as inflicting losses and capturing territory may be rewarded in the game through a single common currency of ‘victory points’, and I discussed how designers often wish to create fairly balanced trade-offs to encourage players to consider a variety of strategies rather than just one stereotyped approach. This requires at least some ability to envisage or construct basic game theoretic matrices to assess the relative payoffs of certain alternative actions for the competing sides. For example, in each of the early turns of the *Second Punic War* game in Chapter 9, the Numidians must decide whether to remain inactive or to raise troops

for Carthage or Rome, after which the Phoenicians must decide whether or not to ravage the Numidians. This may be represented by a simple 3 x 2 matrix, in which the Numidians lose no victory points if they remain inactive and are left unravaged, lose two victory points if they launch a doomed revolt and are ravaged, and lose one victory point in all other cases. If the penalty for being ravaged was to lose two victory points rather than one, this would clearly give the Phoenicians greater bargaining power, since the Numidians might well raise troops for their Punic overlords so as to limit their loss to one victory point per turn instead of the two or three victory point loss they would otherwise be likely to suffer. Similarly, in *Fire and Movement* and *Block Busting* in Chapter 11, adjusting the relative payoffs for breaking enemy units, retaining defenders on the board and occupying the defending board edge would significantly affect the choices of the contending players. You need to be able to weigh up and balance these competing imperatives just as you do when trading pieces during a game of chess, and drawing simple matrices like that in Figure 1.2 can be a helpful way of clarifying the situation.

A key difference between wargames and chess is, of course, the presence of a random element alongside the variation produced by player decisions. Hence, you need to be familiar with at least the basic principles of probability analysis. The first and most important aspect is to be able to work out average risks and payoffs from a given action. This is simply a matter of adding up all the payoffs from a given set of equally likely outcomes, and then dividing by the number of separate outcomes to work out the arithmetical mean. Hence, if a given attack will inflict one hit on a die roll of 5 or 6, the average payoff of that attack is 0 + 0 + 0 + 0 + 1 + 1, all divided by six, or one-third of a hit. Such averaging may be used to analyse the respective merits of different alternatives, as outlined in the previous paragraph. For example, in a 2:1 attack in *Hell's Gate* in Chapter 10, the combat results table in the plates section shows that the average payoff will be one-third of a hit in a normal attack (which succeeds only on a roll of 5 or 6), rising to an average of one entire hit in an all-out attack (0 + 0 + 1 + 1 + 2 + 2, all divided by six). The cost of this extra two-thirds of a chance of hitting is that one attacking unit must suffer an automatic step loss itself, so the cost outweighs the benefit, and all-out attacks at such odds are worthwhile only if the broader strategic context makes it imperative to break through quickly, regardless of the cost.

Angels One Five offers a more subtle example of a similar calculation. Consider the respective merits of attacking medium bombers from different directions. A deflection shot from the rear quarter gives the interceptors a +2 modifier and the bombers a +1 modifier, so on a roll of 4 the interceptors score a hit, on a roll of 5 both sides score a hit, and on a roll of 6 the interceptors are hit but inflict two hits themselves. The average surplus hits which the interceptors score are thus 0 + 0 + 0 + 1 + 0 + 1, all divided by six, or one-third of a hit. In an attack from directly behind, the interceptors' net modifier rises to +3, so their surplus hits increase to 0 + 0 + 1 + 1 + 1 + 1, all divided by six, or two-thirds of a hit. In a head-on attack, the modifiers are +2 for the interceptors and 0 for the bombers, so the surplus hits are 0 + 0 + 0 + 1 + 1 + 1, all divided by six, or one-half of a hit. In a front quarter attack, the modifiers are +1 and 0 respectively, so the surplus hits are 0 + 0 + 0 + 0 + 1 + 0, all divided by six, or one-sixth of a hit. This suggests that the rear attack, with its payoff of two-thirds of a hit per attack, is the best bet. However, we have not yet considered how many attacks each interceptor unit gets to make. When attacking from the rear hemisphere, the interceptors are hit and driven off on every roll of 5 or 6, but this occurs only on a roll of 6 when attacking from the front hemisphere. Hence, the interceptors will manage an average of only three rear attacks before being driven off by the bombers' gunfire, compared to an average of six frontal attacks. The total average surplus hits scored by interceptors that attack unescorted bombers repeatedly from the same direction until they become spent thus rise to one hit (three times one third) for rear quarter attacks, two hits (three times two thirds) for rear attacks, three hits (six times one half) for head on attacks, and one hit (six times one sixth) for front quarter attacks. This makes head-on attacks seem the best overall bet, but, in practice, the much greater time needed to launch such attacks and the vulnerability this creates to the escorts mean that interceptors are better off making a balanced mix of opportunistic attacks from a variety of directions.

Compound probabilities arise when two dice are rolled successively or in combination. The safest way of working out average outcomes in this case is to create a 6 x 6 matrix with the results of one die roll along each axis, and then to fill in all of the 36 possible outcomes as in Figure A3.1. Hence, in *Fire and Movement*, there is a five-sixths chance of a given hex containing open farmland (30 divided by 36), a one in twelve chance of its containing a ridge (3

divided by 36), a one in eighteen chance of its containing woods (2 divided by 36), and a one in 36 chance of its containing a farm (1 divided by 36). In *Block Busting*, when a defending unit is fired on from across the street and then from an adjacent building hex (needing a roll of 4, 5 or 6 to hit in each case), there is a one in four chance of the target remaining unscathed (9 divided by 36), a one in two chance of its being suppressed (18 divided by 36), and a one in four chance of its being broken by two successive hits (9 divided by 36). In *Angels One Five*, heavy fighters which must dice twice for airspeed adjustment and take the lower roll have an 11 in 36 chance of scoring 1, a 9 in 36 chance of scoring 2, a 7 in 36 chance of scoring 3, a 5 in 36 chance of scoring 4, a 3 in 36 chance of scoring 5, and only a 1 in 36 chance of scoring 6. Similar principles apply when rolling three or more dice, although here it is easier to multiply probabilities than to use a matrix. For example, let us say that the Romans in the *Second Punic War* game carry out their planned invasion of Africa on turn one rather than reinforcing the defence against Hannibal, and that the Numidians rise to support them, leaving both sides with three armies in the combat. Since each army in Africa hits on a roll of 4, 5 or 6, the chance of either side wiping out the other by scoring three hits at once is one half times one half times one half, or one in eight. To win the game outright, the Romans must be left with at least one surviving army in the region, so their chance of achieving this is one eighth times seven eighths, or nearly 11 per cent. Of course, this is a high-stakes gamble, since the chance of Hannibal winning a blitz victory in Italy is thereby significantly increased.

A common way of exploiting compound probability is to roll two dice and add the scores to give a total between 2 and 12. As may be seen from Figure A3.1, this gives a 1 in 36 chance of scoring a 2, a 1 in 36 chance of scoring a 12, and a bell curve of increased chances of each number in between, peaking with six chances out of 36 of the mean roll of 7. I use such a two-dice system in my *Lost Battles* book to achieve very small probabilities of events such as generals being killed while rallying, and also to allow combat modifiers to have a smoother and more even effect regardless of the base dice roll required.[8] With a single die roll, a +1 modifier doubles the chance of hitting if the score needed is 6 or more, but only increases the chance by a third if the score needed is 4 or more. With a two-dice roll, a +1 modifier increases the chance of hitting by two-thirds (from 6 to 10

out of 36) if the score needed is 10 or more, but still increases it by two-fifths (from 15 to 21 out of 36) if the score needed is 8 or more. Another way of smoothing the impact of die roll modifiers is to rule that scores that exceed the required basic hit roll by a certain threshold will inflict two or more hits rather than just one, and I use this mechanism in *Hell's Gate*, *Big Week* and *Angels One Five* as well as in *Lost Battles* itself.

First die roll	Second die roll					
	1	2	3	4	5	6
1	1 + 1	1 + 2	1 + 3	1 + 4	1 + 5	1 + 6
2	2 + 1	2 + 2	2 + 3	2 + 4	2 + 5	2 + 6
3	3 + 1	3 + 2	3 + 3	3 + 4	3 + 5	3 + 6
4	4 + 1	4 + 2	4 + 3	4 + 4	4 + 5	4 + 6
5	5 + 1	5 + 2	5 + 3	5 + 4	5 + 5	5 + 6
6	6 + 1	6 + 2	6 + 3	6 + 4	6 + 5	6 + 6

A3.1 Combining two dice rolls

Discussion of compound probability leads us on to the final basic mathematical issue that you need to grasp, namely the range and distribution of random variation, as illustrated in Figure 4.1. Looked at purely from the perspective of average outcomes, there is no difference between a system in which a given attack always inflicts a single hit and one in which it inflicts six hits on a die roll of 6 and no hits on any other roll. The *average* damage inflicted per attack is exactly one hit in either case. Obviously, however, the second system would produce very different results in practice, with massive carnage occurring at unpredictable intervals of time and space, and with the luck of the die playing a significant part in determining victory compared to the evenly distributed attrition and complete predictability of the first system. The more such attacks that are made in the game, the more that the overall results even of the second system will tend towards the average, but the smaller the number of die rolls, the greater the relative variation will be between one playing of the game and another. The formulae to calculate the variation in particular cases get rather complex, so for illustrative purposes I have laid out in Figure A3.2 the chance of achieving a given number of successes from six and twelve die rolls respectively, depending on

the score needed to achieve success, and rounded to the nearest percentage point.[9]

Die roll needed for success	% chance of achieving this many successes from six rolls						
	0	1	2	3	4	5	6
2, 3, 4, 5, 6	0	0	1	5	20	40	33
3, 4, 5, 6	0	2	8	22	33	26	9
4, 5, 6	2	9	23	31	23	9	2
5, 6	9	26	33	22	8	2	0
6	33	40	20	5	1	0	0

Die roll needed for success	% chance of achieving this many successes from twelve rolls												
	0	1	2	3	4	5	6	7	8	9	10	11	12
2, 3, 4, 5, 6	0	0	0	0	0	0	1	3	9	20	30	27	11
3, 4, 5, 6	0	0	0	0	1	5	11	19	24	21	13	5	1
4, 5, 6	0	0	2	5	12	19	23	19	12	5	2	0	0
5, 6	1	5	13	21	24	19	11	5	1	0	0	0	0
6	11	27	30	20	9	3	1	0	0	0	0	0	0

A3.2 Chances of success across multiple dice rolls

As the tables make clear, the smaller the chance of success that each individual die roll has, the higher the degree of random variation relative to the number of successes as a whole. In battles from *Roma Invicta?* in Chapter 9, there is a 93 per cent chance that Hannibal's army of around 30 strength points will score between four and six hits with its six die rolls, since each attack by a full group of five strength points succeeds on a roll of 2 or more. Luck therefore has only a limited impact on the performance of the army. Conversely, in systems where attacks succeed only on a roll of 6, even a dozen die rolls are not enough to make fortune average out, and there is a one in four chance that such attacks will inflict either no hits or four or more hits instead of the expected average of two.[10] That is why *Big Week* and the tactical simulations in Chapter 11 use techniques such as a common combat die roll for both sides, the linkage of ammunition depletion with successful attacks, and the progressive tracking of fractional casualties and ammunition expenditure instead of having individual units removed from play on a single unlucky roll.

Some players feel that my earlier *Lost Battles* system is rather too luck dependent because combat proceeds through a large number of individually low odds attacks, and the new deluxe edition of the simulation includes an optional rules tweak to address this by allowing either player to force the re-roll of a single attack at the expense of passing the next such opportunity to the opponent.[11]

There are plenty of books and websites that present the mathematical concepts I have outlined here in a more rigorous and formal way for those who prefer such a treatment.[12] I know only too well how intimidating formulae, symbols and equations can be to non-mathematicians, so I have done my best instead to adopt an intuitive and common sense approach, emphasising simplicity and practicality, and based very much on the actual simulation designs presented in Part III rather than on abstract overall theory. If you find even this level of maths off-putting, do not despair. Try playing the games themselves, and you will soon find as with any boardgame that things become easier as you 'learn by doing'. Even the design of wargames usually proceeds on an iterative, 'trial and error' basis, instead of all the statistical trade-offs being worked out neatly in advance. The kind of maths used today by professional operational researchers is arcane and inaccessible even to someone like me who studied science as well as history as an undergraduate at Cambridge, so the much wider accessibility of manual wargaming as a tool for modelling conflict is an enormous asset in itself, and not something to be squandered by trying too hard to imbue this fundamentally impressionistic technique with excessive mathematical rigour.[13]

Appendix 4: Using Cyberboard

One of the many ways in which the modern computer age has benefited even manual wargaming is by making it easier than ever to produce and use wargame graphics. Networked play of computer and console games over the internet has become a massive phenomenon in recent years, and it is scarcely surprising that board wargamers have decided to get in on the act. The result has been the production of several different software programs that can represent the physical maps and counters of board wargames as digital images, allowing them to be displayed and used on the computer screen and to be exchanged by email in contests between players thousands of miles apart. I much prefer the feel of physical components, and I have never really had time to engage in such email play. However, the associated software has been absolutely invaluable in supporting my own design and teaching activities over the past decade. There are two main freeware programs currently in use in this field, namely *Vassal* (http://www.vassalengine.org/) and *Cyberboard*. Both have their strengths and weaknesses, but I have come to rely pretty exclusively on Dale Larson's *Cyberboard* software, the latest version of which may be downloaded from his website at http://cyberboard.braininac.com/. Although the program is freeware, Dale welcomes donations from satisfied users, and I would urge you to show your appreciation in this way if you find the software to be anything like as useful as I myself have done.

Cyberboard does have two major limitations that I should mention up front. First, it only runs on Windows PCs, so Mac users are out of luck unless they can get it running within a Windows emulator. Second, the documentation provided with the software is pretty non-existent, and so the program can be hard to learn. For one or both of these reasons, some of my MA students never get on with *Cyberboard*, and prefer to produce their simulation components using their familiar generic graphics

software instead. However, the majority of my students do use the program, and I will now give a series of hints to help you do the same. For more assistance, join the Yahoo! group at http://games.groups.yahoo.com/group/CyberboardML/, where you will find longer illustrated guides on what the program can do. I used *Cyberboard* to produce all of the colour plates and text figures in this book and in my previous book *Lost Battles*, and you can download from the book's website at http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/simwar.aspx the files I have created to allow you to play the various simulations in this book on your own PC screen without needing physical components at all.

Cyberboard is basically an ordinary graphics program with added specialist tweaks to allow you to create hexagon grids and to move small bitmaps over a larger background bitmap, as if moving counters across a map. The software has just two essential components – *CBDesign.exe* and *CBPlay.exe*. As the names imply, the former allows you to create your own 'gameboxes' from scratch, while the latter executable allows you to create and play scenarios from these gameboxes or from gameboxes you have downloaded from the internet. Each gamebox is the virtual equivalent of the map and counters from a physical game. As long as you have the gamebox on your PC, you can use *CBPlay.exe* to display the components and play any scenario of your choice on screen, without needing to open *CBDesign.exe* at all. Note that the digitisation only extends to the graphics – the rules themselves still need to be applied manually. (The assumption that simulations are now all completely computerised goes very deep, and one foreign military officer complained to me last year that he couldn't get my *Cyberboard* files to 'work', since he automatically assumed that they would work by themselves like other computer games.)

I will start by explaining how to play existing gameboxes. First, put the gameboxes for convenience in the same folder as your *Cyberboard* executables, together with the accompanying scenario files. (Gameboxes have the suffix 'gbx', and scenario files the suffix 'gsn'. The latter are small supplementary files that simply detail which counters go where at the start of a particular

scenario, and so save you the bother of setting up the game each time as you would have to do with a hard copy.) Now, open CBPlay.exe, and under the File menu click on ‘open’ and change the file type from ‘game files’ to ‘scenario files’. (Game files record moves and die rolls, and are used when actually playing games by email. I prefer to avoid the hassle, and so I work entirely with scenario files.) You should now be able to point the program to the scenario file which came with your gamebox, and open it up. Click through any warning that the file was created with an earlier version of *Cyberboard*.

Scenarios usually open with the map and the initial counters already displayed. If not, click on the map name on the left-hand menu. You will also need to access the virtual counter trays that contain any pieces not yet deployed, and you can do so from the View menu. Counters may be moved across the map and to and from the counter trays using the usual drag and drop methods, and like physical counters, they can only be in one place at once. Before you make any changes, be sure to use the ‘save as’ option from the File menu to save your scenario under a slightly different name – otherwise, you will overwrite the original file and have to download a fresh one. You can customise the window to show any of four toolbars; I tend to use only the ‘Move’ one. With this, it is simplicity itself to flip double-sided counters over to show their reverse side – just select the counter, and click the ‘turn piece over’ button. You can use the other buttons to change the stacking order of counters atop one another. Rotating counters is a fiddlier business involving cascading options within the ‘Actions’ menu, so *Cyberboard* is not an ideal way to play *Angels One Five* from Chapter 11. However, you can at least select multiple counters at once using the standard Windows trick of holding down the left shift key, so rotating unsupplied counters in *Hell’s Gate* from Chapter 10 is not so much of a problem.

That is really all there is to using existing gameboxes within *Cyberboard*. As with any computer display, there is a starker trade-off between resolution and breadth of vision than with physical maps, but you can use the View menu to toggle between full scale and half-scale boards to privilege whichever of these two aspects you prefer. Besides the gameboxes for my own

simulations, the internet contains hundreds of *Cyberboard* gameboxes produced by enthusiasts to mirror commercially published wargames. Many of these may be accessed through http://loakes.game-host.org/limeyyankgames/gameboxes.php. Such gameboxes exist on the fringes of copyright, and are tolerated only because they are useless without the published rules. It is a condition of using them that you already have a physical copy of the game concerned.

I will now turn to the rather more involved process of using *Cyberboard* to generate components for your own wargame designs. I suggest that you open some existing gameboxes with *CBDesign.exe* and explore them to get a sense of how things work before you try creating your own. When you are ready, open *CBDesign.exe*, and create a new gamebox. Save it in the same folder as your *Cyberboard* executables, and save it regularly thereafter, since the program does crash at inconvenient times. Click ‘playing board’, and decide what kind of a grid you want, in terms of the size and number of cells. Cells need to be big enough to allow fine details on the counters, but not so big that you can fit only a tiny proportion of the board on the screen at once. If you don’t want a regular grid, just make the entire board one enormous rectangular cell. Click OK to open the board, and explore the buttons along the top. Especially useful are the board tool buttons and the scale toggle. You can uncheck the colour palette and/or tile palette to maximize the board area displayed. In the Tools menu, check ‘drawing tools are sticky’ if desired, to avoid the pointer always reverting back to a standard selector after each operation.

There are three drawing layers, accessible through the top buttons. If you have a template for the map (e.g, from an atlas), then scan it as a bitmap outside *Cyberboard*, and rotate and resize it as desired using your paint program, so that the scale in pixels matches that of your grid, as described in Appendix 3. Go to the lowest board layer, and use the Edit menu to import the template into the board. You can then move it around by clicking and dragging. Once the template is in place, you are ready to trace the details you need (such as coastlines, rivers, roads and cities), modifying their position to conform to the grid if desired.

The colour palette shows the line colour (left click), the width of the line in pixels, and the fill colour (right click). Fine-tune colours by sliding the bar across the spectrum, moving the cross, then clicking in the box, or shift clicking in a blank palette box to store it. To match a colour used already, left click it using the ‘pickup color’ tool, then control left click in one of the blank colour boxes to put it on the palette.

The middle board layer allows you to fill entire cells with colour, using the ‘color cell’ tool. In hex boards, this is a very simple basic way of creating an entire map with different coloured hexes for sea, land, hills, woods and so on. Erase using the eraser. More precise map drawing can be done on the top layer. To draw irregular lines with no fill (for instance, for winding rivers), right click in the no colour box, then select the polygon tool. Click and hold the left mouse button as you draw, then double click to finish, or press escape to cancel. To draw irregular blobs such as woods or hills, choose the fill colour, then draw the line round back on itself to enclose the required area. To erase, select that section and press delete on the keypad. To draw the cell border lines over the top, or to change the cell border colour, use the ‘board properties’ item on the Edit menu. To place text, use the text tool, after selecting a colour and choosing the font on the tools menu. Move text by selecting and dragging, or modify it by double clicking. To move one piece of text or artwork behind or in front of others, select it and use the buttons at the top. Once you have finished with the template on the bottom layer, you may right click it and delete it, though if you prefer you may leave it in place as a background for the map, as I have done with the NASA images on my *Roma Invicta?* and *Big Week* maps from Chapters 9 and 10.

To create repeating terrain (such as a woods pattern or the houses on the *Block Busting* map from Chapter 11), make a tile image group in the gamebox, and create a new tile whose size is based on the cells on your board. Each tile has three different sized variants to match the different zoom levels of the board, and you will need to complete all three individually or the tile will just show up as a white square at some zoom levels. Use the View menu to zoom in to the tile for greater precision. If using hexes, go on the Tools menu to apply a cell mask to the full scale and half

scale tiles. Choose the transparent colour, and use the fill tool on the tile tool palette to make the full and half scale tiles transparent. Then draw your desired pattern in any other colors using the pixel pencil or brush. Colour the whole of the tiny tile accordingly. You may now return to the board, and enable transparent tiles in cells in the board properties section of the Edit menu. At the middle layer, open the tile palette and select your chosen tile. You may now use the tile tool to spread it across as many cells as desired. It will align with each cell, and colours from the bottom layer will show through, though fills from the middle layer will not. You may modify the original tile, and all tiles on the map will update accordingly.

To make tiles for counters, use the same procedure to create a tile, but choose a tile size that will fit comfortably within a cell, and do not apply any cell masking or transparency. Note that counters need to be significantly narrower than the width of a hex if they are to fit inside it properly, so don't accept the option of basing your counter size on the width of your hexes. It is very important to exit the tile after each stage of editing and use the button at the bottom to clone it, so that you may go back and clone half-finished tile patterns multiple times without having to draw each counter individually from scratch. Fill all three sizes of tiles with the same background colour, which will stand out well on the map. Choose a contrasting colour and an appropriate width of line, then use the geometric shapes from the tile tool palette to produce boxes on the full and half size tiles to show unit-type symbols like those in Figure 5.3. You may instead draw a silhouette using the pixel pencil, as in *Roma Invicta?* and the tactical games in Chapter 11, and you may select, copy, paste and move this silhouette to duplicate it elsewhere on the tile. Add appropriate numerical ratings to the full- and half-scale versions of each tile, using the text button. To change the colours on tiles, clone them, and use the 'change color' tool to replace the colour you click on with that you now have selected. Add historical designations to distinguish individual units, using the 'rotate tile' function on the Tools menu to turn tiles round as required.

Once you have drawn the tiles to form the front and back of each counter, create one or more playing piece groups from the

main gamebox menu. Click on the ‘new’ button at the bottom to make counters from the tiles. Select a front and back for each counter, and add it in the desired quantity. When all the counters are made, save and exit the program.You can now open *CBPlay.exe* and make a new scenario, pointing the program to the gamebox you have just created as the source for the game components. Click on playing boards, and select the board you have already created. Then click on playing piece trays, and create one or more new ones (usually one per opposing side). Select and edit each tray, and copy any or all of the playing pieces from your gamebox into that tray. You may now open and maximise the board, open the playing piece trays, and drag counters onto the board to create an opening deployment just like the ones you found in other people’s scenario files.

To produce a hard copy of the map, you must open the board in the scenario (not gamebox) file, make sure it is at full size, and use the ‘hide pieces’ button in the Edit menu to remove the counters temporarily. Also in the Edit menu, you then simply choose to ‘save board image in file’ to save a bitmap of the board in the current folder. You may use a similar procedure with the counters in place in any desired configuration to produce illustrations like those in Part III to accompany examples of play in your rules. Once you have the bitmap for the playing board, you can print it our using the techniques described in Appendix 1.

To produce a hard copy of your counters, you should first make a new playing board in your gamebox, using a rectangular grid with cells the same size as your counters. Go to the middle layer, open the tile palette, and slide the fronts of the counters into place in the cells in the top half of the grid to create a countersheet. Do the same with the backs of the counters in the bottom half of the grid, remembering that they should run from right to left so that the individual counters match up when rotated and stuck on the back of the top counter panel. Save and exit the gamebox, go into your scenario file, select and open the countersheet board, and save it as a bitmap. You may now print it out and construct the individual counters as explained in Appendix 1.

These hints cover only the basic operation of the *Cyberboard* program, and you should play and experiment freely with the various functions to discover new tricks to employ. One useful feature which one of my students discovered is that you can import bitmaps into tiles, not through a menu option but by selecting and copying the bitmap in an external paint program and then using the Edit menu to paste it into the tile. This allows you to put scanned graphics on your tiles, and I used it to add the NASA imagery to the hex based terrain tiles in *Hell's Gate*. It also allows you to use an iterative approach to place tiles within tiles, by creating a supplementary playing board the same size as a counter tile, putting multiple overlapping smaller tiles on this board (as with the troop graphics in *Roma Invicta?* and the tree graphics in *Fire and Movement*), exporting the board as a bitmap via the scenario file, and then pasting it back into a single counter tile in the gamebox. Iteration is also a good way to overlay features such as turn tracks or the combat results table in *Hell's Gate* onto the main map, by creating them as separate rectangular gridded playing boards, exporting them as bitmaps via the scenario file, then pasting them back into the top drawing layer. You should start off with simple and functional graphics, but in time you may wish to employ such subtleties to make your design more attractive. The only limit is your own ingenuity, but the key thing is to use *Cyberboard* (or whatever other graphics program you prefer) to make your own study and design of simulations as smooth a process as possible.

Appendix 5: Kartenspiel

As I said in Chapter 3, my colleagues and I ran this simple abstract game for the 400 Staff College students a decade ago, to follow my lecture on Clausewitz by modelling his strategic ideas using a card game – the very thing he said was the closest analogue to war.[14] I will now present the full rules as distributed, followed by the notes I gave to the military and academic tutors. (The game is designed for ten players, but it can be played by just two army commanders if desired.)

INTRODUCTION

This game illustrates the interactive nature of strategy through a generic simulation of a typical Napoleonic land battle like Austerlitz. Your syndicate will be split into two opposing teams of five, one of whom represents the army commander and the others his four corps commanders. The teams should face one another across the tables as shown here:

Red Army Commander

Red Corps I	Red Corps II	Red Corps III	Red Corps IV
Black Corps I	Black Corps II	Black Corps III	Black Corps IV

Black Army Commander

The game is played with a standard pack of cards, with the jokers removed. Each army commander is given half the cards, red or black as appropriate, with the six picture cards representing cavalry divisions and the 20 other cards representing infantry divisions. The other values on the cards are ignored, and artillery is assumed to be integrated into the 26 cavalry and infantry divisions on each side.

The game is played in turns, during each of which the two sides simultaneously complete three successive stages – redeployment, attack declaration, and combat resolution. The object of the game is to break the opposing line at any point, and so win the battle.

REDEPLOYMENT

All divisions are initially held by the army commander, but in any redeployment phase, he/she may transfer any or all of them in any combination to the corps commanders, by giving them the cards concerned. Some divisions may be retained in reserve for as long as desired, but once passed to a corps commander they may not be transferred again, either to another corps commander or back to the reserve. (It was very hard in this era to disentangle forces once committed.) Card holdings and transfers are secret, and should be hidden from the opposing team (to represent the ‘fog of war’ caused by terrain, black powder smoke etc.). Note that it is risky to leave any corps with fewer than three divisions, lest it be broken before reinforcements can arrive.

In each redeployment phase, you should discuss quietly and privately among your team what transfers should be made. Each corps commander will doubtless press hard for reinforcement, to gain the glory of breaking the enemy line or to avoid the ignominy of having his own corps broken, and the army commander must balance these demands against the maintenance of an uncommitted reserve for the future. Discussions will be strictly limited to a maximum of two minutes during initial deployment, and one minute thereafter. Communications between team members are prohibited during other phases.

ATTACK DECLARATION

Once redeployment has been completed, the eight corps commanders must declare any attacks. This occurs simultaneously, as in the ‘scissors, paper, stone’ game – on a count of three, each corps commander must present either an open palm to signify attack, or a closed fist to signify defence. Prevaricators (umpire’s judgement) have their selection made by the opposing corps commander, to simulate a mix-up in orders. Once all attacks have been declared, the combats are resolved one after another, moving along the line from Corps I to Corps IV. In the unlikely event that no attacks at all are declared on any turn, night is assumed to have fallen with the battle undecided. If this happens, all surviving divisions are returned to the army commander, together with half (rounded up) of that side’s lost infantry divisions and half its lost cavalry divisions, which are assumed to have rallied. The battle then restarts the next day with a new initial deployment phase.

COMBAT RESOLUTION

Combats occur between the two corps directly opposite one another. If both corps defend, nothing happens and their force levels are not revealed. If one or both corps attack, then all the cards of both corps must be revealed temporarily on the table. If cavalry are present in either corps, their commander must now state whether they are charging. If both corps contain cavalry, charges are declared simultaneously, using the same procedure as for declaring attacks. Once the two corps have revealed their forces and declared any cavalry charges, combat losses are determined and applied.

Count up the number of divisions in each corps, counting charging cavalry as two divisions each. If (and only if) the side with the larger total is attacking, the enemy loses one division, and if the attacker's total is at least twice that of his/her opponent, the enemy loses two divisions instead. Once these losses have been applied, the attacking corps (both corps if both declared an attack) automatically loses one division, unless fewer than two enemy divisions were present at the start of the combat. (As Clausewitz said, Napoleonic combat was an irredeemably bloody business.) For example, if a corps with four infantry and two cavalry divisions attacks a defending corps with two infantry and two cavalry divisions, and the attacking cavalry (only) declare a charge, the totals are 8 and 4 respectively, and so the defenders lose two divisions and the attackers one. If neither side's cavalry had charged, the totals would be 6 and 4, and so both sides would lose one division. If only the defending cavalry had charged, the totals would be equal at 6 and 6, and so only the attackers would lose a division. If the smaller force had attacked instead of defending, and both sides' cavalry had charged, the totals would be 8 and 6, so the larger force would lose one division and the smaller force two divisions overall.

The cards of lost divisions are given immediately to the umpire. Corps commanders may choose which of their divisions (preferably infantry) suffer losses, except that if they declared a cavalry charge, all their losses this turn must be taken from cavalry divisions as far as possible. Cavalry never count double

when it comes to the application of losses. If all of a corps' divisions are lost, excess losses are ignored. After all combats have been resolved, the game ends if any corps which engaged in combat this turn (other than mutual defence) has no divisions left. That side's line is considered broken, and the army is defeated. If this happens to both sides at the end of the same turn, the side that has had more divisions shattered during the game is the one that breaks. If this total, too, is equal, the battle is a draw.

AN ASYMMETRIC VARIANT

Once you have played this symmetrical version of the game, you can try an asymmetric version in which one side has a smaller army but enjoys greater flexibility of command. In this version, one side starts with one fewer cavalry and three fewer infantry divisions. However, during redeployment phases, that side's army commander may not only move divisions out of the reserve, but may also order the transfer of any number of divisions directly between the corps commanders (even non-adjacent ones). Also, attacks and cavalry charges are no longer declared simultaneously, but are declared first by the other army. This simulates one side being able to manoeuvre its forces more freely, to mask its changing deployment, and to anticipate enemy actions (analogous to operating with a tighter 'OODA loop'). You might care to think of the smaller army as representing Wellington's outnumbered forces at Waterloo, using the protective ridge line to hide their deployments and so counter the ill-coordinated French attacks.

THE BOTTOM LINE

The point of the game (besides being a bit of fun to offset the heavy burden of academic philosophising!) is to explore the practical interaction of principles like ‘surprise’, ‘offensive action’, ‘concentration of force’ and ‘economy of effort’, and to illustrate how limited intelligence injects Clausewitzian uncertainty and risk taking, and Sun Tzu-like bluff and double bluff, into what would otherwise be an entirely calculable, chess-like contest. Can you afford to leave one corps weak so as to bolster your decisive attack elsewhere, in the belief that the specific opposing corps commander is unlikely to be trusted with major forces, or will the enemy team have anticipated such a judgement and so have done precisely the opposite of what you might expect? Should you choose one point of attack and hammer away at it from the outset, with the risk that enemy reinforcements will stymie your predictable steamroller, or should you hold back and launch feints to misdirect enemy reserves, with the risk that your eventual offensive will be too late and too weak to succeed? How many divisions of what kind should you yourselves keep in reserve, and should they be committed to reinforce success or to retrieve failure? All in all, playing *Kartenspiel* may help you to make some sense of Clausewitz’s apparently ridiculous suggestion that war is like a game of cards. If nothing else, it will give you plenty of unrealistic parallels to identify in the subsequent seminar discussion! Enjoy.

NOTES FOR TUTORS

Kartenspiel differs from the previous game Gotcha! in that it is played between teams rather than between pairs of individuals. This should make it easier to run, partcularly with students whose English is poor. Teams can be designated by the tutors, with appropriate individuals nominated as army commanders. If there are fewer than ten students present, tutors or other guests may fill the slots, although one tutor should remain as umpire to keep the game moving. If necessary, the number of corps per side may be cut to three, reducing player requirements to eight.

As with Gotcha!, the key thing to remember is that *Kartenspiel* is a means to an end, not an end in itself. It is intended merely as a lively and thought-provoking prelude to the main part of the seminar discussion. This means that the game itself must not drag on too long, and that subsequent discussion of the game must be broadened quickly into discussion of the other substantive issues. Most students should have read the game instructions beforehand, so there should be no need for lengthy preliminary explanations. Five minutes should suffice, with perhaps a demonstration of an individual combat like the example given in the rules, and with the opportunity for students to ask questions to clarify points of uncertainty. Needless to say, it is vital that the umpire have a clear grasp from the outset of how the game works! A clinic will be run just before the seminar to help with this.

The main duty of the umpire during gameplay is to keep the game running quickly. Discussion during redeployment phases should be strictly limited to two minutes in the first such phase and one minute thereafter – less if possible. Attack declarations take only a few seconds, and each successive combat between opposing corps should also take only 30 seconds or so in total, as long as the umpire has a clear grasp of how losses are calculated – **a key requirement**. Since most games will last only around five turns before a result is achieved, each game should take only fifteen minutes or under to play. A few very evenly matched games may bog down as the opposing forces become too small to launch effective attacks, in which case the umpire should step in to call a halt and move on.

The only slightly complicated aspect of the rules is the cavalry subsystem. This serves to add some period flavour to the game, and to add a degree of tactical interest for the corps commanders, who might otherwise have little more to do than executing the army commander's instructions. As the combat example illustrates, cavalry charges offer a way of shifting the combat odds to one's advantage, at the cost of exposing the precious cavalry to attrition. The contingent calculations necessary during mutual declarations of cavalry charges offer a microcosm of the larger uncertainties associated with mutual commitment of reinforcements at the level of the armies as a whole.

There should be time to play the game through a second time using the asymmetric variant, especially since the players will now be familiar with the system. Army commanders should be changed the second time round, perhaps giving command of the smaller army to the corps commander who achieved the decisive breakthrough the first time. The game should remain fairly balanced, and it is by no means certain that the more flexible side will win, even though it has 85 per cent of its original forces. This illustrates Clausewitz's point that, in the bloody attritional struggles of Napoleonic times, surprise and fancy footwork could not entirely substitute for 'big battalions' of well-motivated troops.

It is probably a good idea after each game to spend a minute or so allowing each commander to explain his strategy and how the game went from his perspective. Once gameplay is complete, the points highlighted at the end of the rules offer several possible topics for transitional discussion. Another obvious subject is the period specificity of the game system. There is little point in teaching twenty-first-century commanders how to fight a Napoleonic battle, so one might ask which aspects of the game remain relevant to the very different conflicts of today. Another possible angle is to discuss whether the asymmetric version of the game properly reflects the mechanics of the OODA loop. In fact, it uses unrealistic flexibility of lateral movement within the frontline as a surrogate for an impractically complex system which would have turns of a different length for the two sides. However, the key thing is not to get bogged down on such issues, and instead to move on to more substantive matters in the second half of the

seminar. Finally, please remember to collect up all the cards, to save us buying new packs if we run the game again next year.

Notes

Notes to Introduction

1 Clausewitz (1976), p.86.
2 Cornell (2002), Del Corno (2002), Hanson (1989), Sabin, van Wees and Whitby (2007), Vol. I.
3 Auguet (1972), Cornell (2002), Strauss (2009).
4 Barber and Barker (1989), Zotz (2002).
5 Gush and Finch (1980), pp.21–3, Perla (1990), pp.15–23, Singh (1989).
6 Huizinga (1970), p.110.
7 Cornell and Allen (2002), p.12.
8 Clausewitz (1976), p.75.
9 Luttwak (1987), pp.4–5.
10 Ibid., pp.3–7.
11 Murray and Millett (2000), pp.58–62, 411–20, 463–71.
12 Sun Tzu (1963), pp.66–70 and 85.
13 Perla (1990), pp.23–30.
14 Allen (1987, 2002), Brewer and Shubik (1979), Hausrath (1971), Perla (1990), Smith (2009b), Wilson (1970).
15 Sabin (2002a).
16 To take Waterloo as an example, my personal collection alone includes Schutz (1962), Dunnigan (1971a), Chadwick (1975), Taylor (1979a), Emithill (1982a), Zucker (1983, 1985, 1986, 1998), Davis (1983), Braun and McEvoy (1991), Bambra and Earle (1993), Dalgliesh, Gutteridge and Gibson (1993), Berg (1994, 2002), Tiller, Rose and Hummel (1996), Wimble (1996), Balkoski and Bryant (2001), Miranda (2007a) and Wallace (2009).
17 See, for instance, the detailed game studies of the battle of Novorossisk in February 1943 in Radey (1982), Trout et al. (2007).
18 Berg et al. (1977), Campion and Patrick (1972), Palmer (1977).
19 Featherstone (1988).
20 Barker (1993), Barker and Bodley Scott (1993), Gush (1979), Head (1992), Heath (1978), Wargames Research Group (1971, 1973, 1979); http://www.pikeandshotsociety.org, http://www.soa.org.uk, http://www.sotcw.net, http://www.wargamedevelopments.org.
21 The results are well illustrated in Dille and Emrich (1995).
22 Dunnigan (1992), pp.171–221, 300–15, Halter (2006).
23 These review magazines give a very good sense of the board wargames corpus, but are themselves highly unlikely to be found in libraries.
24 See, for example, Adkin (2001), who reconstructs Waterloo in significant detail, but whose extensive bibliography includes none of the wargames listed in my earlier reference.
25 McGuire (1976a), Perla (1990), pp.177–9, Sabin (2002a), Schlesinger (1993), Smelser and Davies (2008).
26 See, for instance, Chandler (1967), Goldsworthy (2006), Nosworthy (2005).

27 See, for example, Hanson (2007), p.17, with his dismissive passing reference to ‘war-gaming or “blood and guts” aficianados’.
28 Armstrong (2009b), Lewis (2010). For a more serious perspective on gaming, see Salen and Zimmerman (2004).
29 McGonigal (2011), p.19.
30 Allen (1987), Perla (1990).
31 Berg et al. (1977), Dunnigan (1992), Freeman et al. (1980), Palmer (1977, 1980b).
32 Martin (2001).
33 Even if we focus only on generic introductions to figure gaming across all periods, the list includes works such as Featherstone (1962, 1970a, 1988), Morschauser (1962), Wise (1969), Gush and Finch (1980) and Quarrie (1980, 1987).
34 Sabin (2011a). See the flood of new board wargame announcements on http://www.consimworld.com.
35 Sabin (2007a), Sabin and Mahaffey (2011); http://www.fifthcolumngames.co.uk.

Notes on Chapter 1

1 Dunnigan (1992), p.13.
2 Perla (1990), p.164. In Perla (2008: 24), he amended this to say simply that: ‘A wargame is a warfare model or simulation in which the flow of events shapes, and is shaped by, decisions made by a human player or players during the course of those events.’
3 Sabin (2002a), pp.194–5.
4 Klabbers (2009), Schlenker and Bonoma (1978), pp.28–32.
5 Hays (2005), pp.13–5, Rubel (2006), pp.113–5, Wilson et al. (2009), pp.217–9.
6 Abt (1970), Klabbers (2009), pp.461–2, Smith (2009b).
7 Schlenker and Bonoma (1978), p.32.
8 Dunnigan (1992), p.236.
9 Ibid., Oswalt (1993), pp.156–8.
10 McCarty (2004) p.255.
11 Sabin (2007a), pp.30–32, 101–5, 133–6.
12 Duffy (1985), Marsden (1971).
13 Gat (1989), pp.79–94, Paret (1986) pp.113–9,189–91.
14 Lanchester (1995), Chs 5–6.
15 Bellamy (1990), pp.45–50, Dupuy (1992a), pp.166–74.
16 See, for example, Engel (1954), Homer-Dixon (1987), Hung et al. (2005), Kaup, Kaup and Finkelstein (2005), Kress and Talmor (1999), Taylor (1974).
17 Lanchester (1995), pp.47–9, Sabin (2007a), pp.11–14.
18 Grant (1970), pp.71–3.
19 Epstein (1985), Lepingwell (1987).
20 Air Ministry (1963), Blackett (1962), Part II, Kirby and Capey (1997), McCloskey (1987), Wakelam (2009).
21 Hillier and Lieberman (1995), Taha (1976).
22 Brewer and Shubik (1979), Cohen (1988), Davis and Schilling (1973), Epstein (1988), Huber, Jones and Reine (1975), Kaplan and Sherwin (1983), Wilson (1970).
23 Allen (1987), Chs 9–10, Enthoven and Smith (1971), Gartner and Myers (1995).
24 Forder (2004), Taylor and Lane (2004), US Army and Marine Corps (2007).
25 Biddle (1996), Biddle and Friedman (2008),Gass (1997), Moffat, Campbell and Glover (2004), Oswalt (1993), Ozdemirel and Kandiller (2006), Perry and Moffat

(1997).

26 Zetterling (1996 and 2000), Zetterling and Frankson (1998, 2000, 2008).

27 Gooderson (1998).

28 Rowland (2006).

29 Dupuy (1979), especially Chs 3–4.

30 Dupuy (1992a), Ch. 8.

31 Ibid., Chs 11 and 16.

32 Dupuy (1979), pp.99–110, 130–9, Hastings (1984), Ch. 6, Pollack (2002), van Creveld (1983), Zetterling (2000), Appendix 10.

33 Biddle et al. (1991).

34 Biddle (2004).

35 Ellis (1990), Glantz (2005), Millett and Murray (1988), Overy (1995), Sabin (2009a).

36 von Neumann and Morgenstern (1953).

37 Bennett (1979), Ch. 4, Haywood (1954), Ravid (1990).

38 Berkovitz and Dresher (1959), Danskin (1962),Thomas and Deemer (1957).

39 Kuenne (1965).

40 Schelling (1960).

41 Freedman (2003),Kaplan (1983).

42 Schelling (1960), pp.207–66.

43 Schelling (1966).

44 Newhouse (1989), Scott (2007), Thorson and Sylvan (1982).

45 Clodfelter (1989), Schelling (1960), Chs 2–3, (1966), pp.69–91.

46 See, for example, the game theoretic analysis of the Anglo-German naval race in Kydd (1997).

47 Jervis (1988).

48 Bennett (1995), Shubik (2002a).

49 Brams (1994), Stone (2001).

50 For an exception, see Shubik (2002b).

51 Gorvine (1970), Keller (1975), McDaniel (2000).

52 Steven Spielberg, Paramount, 1998.

53 Beevor (1999), Glantz (2009).

54 Clarke (1966, 1996, 1997), Morgan (1980).

55 Wells (1908, 1933).

56 Bidwell (1978), Hackett (1978, 1982), Macksey (1985), Sabin (1986).

57 Dupuy (1992b), Heisbourg (1997), Pearson (1999).

58 Gallagher (2007), Hearnshaw (1929).

59 Grigg (1980), Stolfi (1992).

60 Downing (2001), Macksey (2001), Quarrie (1988), Tsouras (1994a, 1997).

61 Cowley (1999, 2002), Dupuy (1984), Macksey (1995), North (2000), Spick (2005), Tsouras (2001, 2002, 2003, 2004). Showalter and Deutsch (2010) go further by including 60 ‘what if?’ discussions by historians such as Glantz, spanning the whole of World War Two.

62 Ferguson (1998), Roberts (2005).

63 Ferguson (1998), p.68.

64 Black (2008), Roberts (1995), pp.2–8.

65 Evans (1997), Collins (2007).

66 Black’s talk at King’s College London on 1 October 2010 asked ‘Could the British have defeated the American Revolution?’

67 Overy (1995), Sabin (2009a).

68 Bulhof (1999), De Mey and Weber (2003), Fearon (1991), Hausman (1996), Murphy (1969), Winship and Morgan (1999).
69 Bunzl (2004), Joynt and Rescher (1961), King and Zeng (2007), Landes (1994), Lebow (2000), Sylvan and Majeski (1998).
70 Balfour (1979), Glick and Charters (1983), Mackie (1977), Nofi (1972), Oppenheim (1977), Trengove (1987).
71 Some sense of typical views may be gathered from the transcripts of discussion sessions in Cornell and Allen (2002), pp.222–30, 251–61, 279–316.
72 Spick (1978), p.7.
73 Schlenker and Bonoma (1978). Overy (2010) draws a clear distinction between 'popular' and 'academic' history, and although he typically does not even mention wargaming, he would surely regard it as falling squarely into the former category.
74 McGonigal (2011), pp.11–12.
75 Creative Assembly (2004), Harrison (2004), Sabin (2002a), p.193.
76 Crookall and Thorngate (2009), Garris, Ahlers and Driskell (2002), Hays (2005), Kebritchi and Hirumi (2008), Lean et al. (2006), Moizer et al. (2009), Wideman et al. (2007), Wilson et al. (2009).
77 See, in particular, Showalter and Deutsch (2010).
78 Schut (2007), Vasagar (2010); http://making-history.com.
79 Guillory (2010), Rohrbaugh (2008a), Sabin (2008a), Sauvage (2010); Wolverhampton BA War Studies course at http://courses.wlv.ac.uk.
80 Dunnigan (1992), pp.87–93, 163–7.

Notes on Chapter 2

1 Gribbin (2005), Hawking (2001), Kuhn (1996).
2 For an idea of what can nevertheless be achieved using a combination of historical data and exercise trials, see Rowland (2006). On social science methodologies in general, see Michie (2001).
3 Hill (1974), Madeja (1973), Miranda (1990), Zucker (2005).
4 Featherstone (1970b), p.x.
5 Grant (1976), pp.462–3, (1979), Ch. 1.
6 Allen (1987), pp.11–20, 101–9, Herman (1990).
7 Allen (1987), p.108.
8 Rohrbaugh (2006), p.3.
9 Baney (1981, 1987), Dunnigan (1992), pp.59–60, 225, Poole (1978), Sabin (2002a), pp.208, 228–9.
10 Aceto (2009), Asquith (1988), Burtt, Einhorn and Wilson (2002), Featherstone (1973), Grant (1983), Southard (1987), Swan (1990).
11 Dunnigan (1992), pp.87–8.
12 Ibid., pp.222–4.
13 Chadford (1996), Miranda (2000), Schettler (1991).
14 Dunnigan (1992), pp.91–2, 162, Sabin (2002a), pp.208–9.
15 Miranda (2010b, 2010c), Nord (2009), Palmer (1980b), Ch. 3, Resch (2007), Starkweather (2007).
16 Hughes (2010a), p.21.
17 Rinella (2010).
18 de Vandiere (2010), Euzet (2010), Guenette (2010), Gury (2009), Jarry (2009), Martin (2009, 2010), Nordling (2009a, 2009b, 2010a, 2010b, 2011), Olivier (2009c), Rinella (2009), Rohrbaugh (2008b), Stratigos and Naud (2009).

19 The major US company Decision Games is now producing dozens of ‘Folio Games’ such as Ritchie and Harvey (2010), based on a complete redesign of the simple SPI ‘quad games’ of the 1970s.
20 Dunnigan (1992), p.171, Olivier (1998).
21 Ahmed (2010), Armstrong (2009b), Halter (2006), Zampella et al. (2005).
22 Dunnigan (1992), pp.252–3.
23 See, for example, Španěl et al. (2007), Suglobov et al. (2007).
24 See, for example, Digital Illusions (2004), Spit et al. (2006).
25 Malacher (2010), O’Connor (2003, 2006).
26 Curry (2008a), Rapier (2008), Tilley, Rowland and Pearce (2004).
27 Bryant et al. (2006), Hunter et al. (2004), Tiller (2004), Trout (2007).
28 Halter (2006), Part 1, Smith (2009b), Chs 13–14.
29 Lynch and Tunstall (2008); http://making-history.com.
30 Sabin (2011b, 2011a).
31 Ahmed (2010), Electronic Arts (2007), Zampella et al. (2005).
32 Bernard et al. (2002), Böhmer et al. (2005), Czerwieniec et al. (2002), Grygorovych et al. (2002).
33 De Laurentiis, D. (2000) *U-571* (Universal), Gibson, M. (1995) *Braveheart* (Panavision).
34 Andersson et al. (2003, 2005, 2008); http://making-history.com.
35 The drive for accessibility and flavour so as to reach a larger market often distorts realistic simulation even in hex-based computer wargames, as illustrated in Dille and Emrich (1995).
36 Schwerpunkt (2001, 2005), Trout et al. (2007).
37 Grigsby et al. (2003), back cover.
38 Trout et al. (2003), back cover.
39 This tension over the desirability of ‘role simulation’ was anticipated in Besinque (1987), Perla (1990), pp.305–12.
40 Pulsipher (2010).
41 Bohemia Interactive (2001), Microsoft (2002), Maddox et al. (2002), Creative Assembly (2004), Sabin (2000a), (2007a), pp.xviii, 11–15, Smith et al. (2006), Španěl et al. (2007), Spit et al. (2006), Yavuz et al. (2009).
42 Hill (1980a), Moylan et al. (2004), Pitchford et al. (2008), Stahl et al. (2006), Wargames Research Group (1971, 1973).
43 Dunnigan (1992), pp.300–15.
44 For example, tempting a computer opponent out of a strong position through a feigned retreat may simply be a matter of waiting for it to fail a random ‘die roll’. See Dille and Emrich (1995), p.38.
45 McGonigal (2011), pp.10–11.
46 Ibid., pp.252–3.
47 Koger et al. (2006).
48 Marchand (2009), Martin (1999), Nordling (2010b), Sabin and Mahaffey (2010).
49 Dunnigan (1992), p.253.
50 Perla (1990), p.8.
51 Marsh (1997), Mulholland (2008). The historical weaknesses of one of the simplest games, Dunnigan (1972d), are explored further in DeWitt (1974).
52 Snow (1961).
53 Biddle (2004), Freedman (2005), p.428.
54 Bloodgood (1980), Dunnigan (1979a).
55 Miranda (1990).
56 Berg (1979), Campbell (1980), Pratuch (1980).

57 Stasnopolis (1990), p.55.

Notes on Chapter 3

1 Dunnigan (1973b), Hill and Chadwick (1977), Sunday Times Insight Team (1974).
2 Sabin (2002a), pp.216–8.
3 Campion and Patrick (1972), pp.5–11, Perla (1990), pp.23–34.
4 British Army (1884).
5 Ibid., pp.9–10, 19–26, Table C.
6 Ibid., pp.15–6, 22–3.
7 Ibid., p.18.
8 Curry (2008a), Rapier (2008).
9 Curry (2008b).
10 Perla (1990), Chs 2, 10.
11 Ibid., pp.72–3.
12 Ibid., p.103.
13 Rubel (2006), p.108.
14 Allen (1987), p.111.
15 Dunnigan (1992), p.232.
16 Ibid., pp.241–2.
17 Ibid., pp.240–4. Blucher (1989), pp.39–42, Caffrey (1990, 2000); http://connections-wargaming.com.
18 Blucher (1989), pp.39–40, Dunnigan (1973a).
19 Dunnigan (1992), pp.242–4, 250–1, Dunnigan and Hardy (1984), Morgan (1986, 1988, 1990a), Slavin (1989).
20 Barker (2008), (1993), p.1, Barker and Salt (2006), Barker et al. (2010), Gruenbaum (1991), p.41.
21 Bay (1981), Walters (1990).
22 Dunnigan (1992), pp.242–3, Gruenbaum (1991), p.44.
23 Walters (1990), p.38.
24 Fong (2006), Smith (2009b).
25 Halter (2006).
26 Bohemia Interactive (2001), Chiodo et al. (2005), Španěl et al. (2007), Stahl (2004).
27 Atkins (2009), Bohemia Interactive (2009).
28 Caffrey (1990, 2000), Gruenbaum (1991), Morgan (1990a), Perla (1990).
29 Perla (1990), pp.26–7.
30 Allen (1987), Sabin (2002a), pp.212–4.
31 Dunnigan (1992), pp.267–70, Perla (1990).
32 Kennedy (2009).
33 Szejnmann (2009), pp.4–5.
34 Levine (1992), Price (1973). For more detailed simulations of the bomber offensive against Germany, see Dunnigan et al. (2009), Grigsby et al. (1999), Taylor (1982), Zocchi and Miranda (2007).
35 For more detailed simulations of aircraft carrier duels, which the game most closely resembles, see Dunnigan (1975a), Knight (1992), Taylor (1981a, 1991a), Trout (2007).
36 On Napoleonic battles, see Adkin (2001), Chandler (1967), Muir (1998), Nosworthy (1995). There are literally hundreds of simulation games on the various

individual engagements, as I pointed out in the Introduction with regard to Waterloo.

37 McCarty (2004), pp.263–4.

38 Balkoski (1986a).

39 Dunnigan (1992), pp.252–3.

40 http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/consim.aspx or just Google 'Sabin consim'. Our initial experiments with posting drafts on the website as well were discontinued, because the comments from enthusiasts could not keep pace with the rapid evolution of the designs.

41 Berg et al. (1976), Dunnigan et al. (1975), Hardy et al. (1975), Nelson et al. (1976).

42 Sabin (2008a), p.30.

43 Mulholland (2005), Velicogna (2009). Both students have been inspired to design further simulations for future publication.

44 Creative Assembly (2004), Sabin (2007a).

45 Sabin (1993a).

46 Crookall and Thorngate (2009), Garris, Ahlers and Driskell (2002), Hays (2005), Kebritchi and Hirumi (2008), Lean et al. (2006), Moizer et al. (2009), Schut (2007), Wideman et al. (2007), Wilson et al. (2009).

47 Sabin (2008b).

Notes on Chapter 4

1 Balkoski (2005), Bey (2009a), Dunnigan (1978 and 1982), Dunnigan and Nofi (1994), Editors of Command Magazine (2000), Nofi (1995).

2 Dunnigan (1992), pp.87–93.

3 Berg et al. (1977), Section V.

4 Clark (2001), Gordon and Trainor (2006), Kemp and Hughes (2009).

5 Parshall and Tully (2005), Ch. 24.

6 For exceptions that do provide detailed analyses of the actual or potential clashes around Vyazma in 1942, see Glantz (2000, 2008) and simulations by Bomba (2002) and Knipple (2005).

7 Showalter and Deutsch (2010) is again something of an exception, because of the wide range of different possibilities the book considers.

8 Faringdon (1986), International Institute for Strategic Studies (2010).

9 Ellis (1993), Ellis and Cox (1993).

10 Baker (1986), Banks (1989), Bey (2009b), Esposito and Elting (1999), Keegan (1989a), Natkiel (1982), Symonds and Clipson (1985, 1986); http://www.military.com/Resources/HistorySubmittedFileView?file=History_Maps.htm.

11 A classic example of such literature is Nafziger (1999, 2000, 2001).

12 Delve (1999), Gruenhagen (1976), Jerram (1984), Thompson (1999).

13 Griffith (1987), Hanson (1989), Muir (1998), Nosworthy (1995, 2005), Sabin (1996a).

14 Engels (1978), Gabriel and Metz (1991), Sabin (2000a).

15 Biddle (2004), Dupuy (1979, 1992a), Rowland (2006).

16 Dunnigan (1992), p.114.

17 Berg et al. (1977), pp.44, 52, Dunnigan (1973c, 1976a).

18 Balkoski (1987), p.18, Radey (1982), p.34, Reed (1980), pp.38–43, Simo (2009), pp.50–1.
19 Sabin (2009b).
20 Baggett and Grace (2003) and Matthews (2008) are dreadful, whereas Herman and Berg (2003) and Thompson and Hook (2007) are much more impressive.
21 Carey (2003), Compton (2003).
22 Nakamura (2008), Olivier (2009a), Revenu (2009).
23 Charbonneau and Lombardy (1980), Chuikov (1963), pp.83, 95, Maps 5–6, Helfferich and Hill (1980), Hill (1980b), pp.18–28, Hinkle (2004), Parham (1980).
24 Baslund (1985), Bastable (2006), p.74, Glantz (2009), pp.172–82, 728–9, Greenwood (1989), Hoyt (2001), p.149, Nakamura (2008), Tarrant (1992), pp.73–5, 85, Taylor (2003), pp.289–95.
25 Beevor (1999), pp.128–31, Glantz (2009), Ch. 3, Vasagar (2010).
26 Matthew, 7:1.
27 Glantz (2005), Glantz and House (1995), Goldsworthy (2001), pp.109–51, cf. pp.88–9.
28 Armstrong (2009a), Blaeu and van der Krogt (2006), Davis et al. (1983), Stanley (1982).
29 Hoyle (2010), Sabin (2007a), pp.6–7.
30 Zetterling (2000), Zetterling and Frankson (2000, 2008).
31 Caesar, *Bellum Civile*, III.106, Goldsworthy (2003), pp.46–9.
32 Van Creveld (1985).
33 David (1997).
34 Bennett (1999).
35 Frieser (2005), Ch. 8, argues that Hitler lost perhaps his best chance to win World War Two by his ‘halt order’ at Dunkirk in 1940, for no more substantial reason than to assert his dominance over the German officer corps.
36 Clayton (2003), Chs 1–2, Thompson (2008), Zuber (2007).
37 Adkin (2001), p.76.
38 Dunnigan (1973b), Sunday Times Insight Team (1974).
39 Bomba (1991), Gordon and Trainor (1995), Pollack (2002).
40 Bomba (2001), Gordon and Trainor (2006).
41 Sabin (2010c).
42 Germany’s rapid conquest of France in 1940 is often cited as a case where everything went right for the aggressors. See May (2000).
43 Gribbin (2005).
44 Taleb (2008), p.127.
45 Perla (2008), pp.26–7.
46 Bomba (1992), Hargreaves (2008), Train (2011).
47 Hausrath (1971), pp.22–5, Perla (1990), pp.41, 49, 52–3.
48 Hausrath (1971), p.32, Perla (1990), pp.42–3, 72–4.
49 Perla (1990), pp.45–8, Rubel (2006), pp.124–5.
50 Buckingham (2004), p.150, Hausrath (1971), pp.27–8, 32–4, Perla (1990), pp.44, 53–4. For modern simulations of the Hürtgen battle, see Nelson et al. (1976) and the imminent monster game by Youst (2011).
51 Allen (1987), Brewer and Shubik (1979), Dunnigan (1992), pp.235–40, 270–4, Forder (2004), Hausrath (1971), Huber, Jones and Reine (1975), Perla (1990), pp.105–8, Wilson (1970).
52 Hausrath (1971), pp.35–7, Perla (1990), p.156.
53 Allen (1987), Ch. 7, Brewer and Shubik (1979), pp.100–9, Hausrath (1971), Ch. 9, Perla (1990), pp.108–14.

54 Gile (2004), Perla (1990), pp.97–103.
55 Dunnigan (1992), pp.256–64.
56 Moynihan (1987), Perla et al. (2000).
57 Rubel (2001, 2006).
58 Rubel (2006), p.111.
59 Overy (1997), p.91.
60 For an alternative perspective on the benefits of historical wargaming, see Glick and Charters (1983).
61 McCarty (2004), p.256.
62 Berg et al. (1977), pp.44, 52.
63 Inns, N. (2007) *Grant vs Lee: The Overland Campaign*: http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/consim.aspx.
64 Daly (2002), pp.32-45, Goldsworthy (2001), Ch. 4, Sabin (2007a), pp.xvii, 77–87, 183–6.
65 Compare, for instance, the reconstructions of Alexander's victory at the Hydaspes in Bosworth (1995), pp.262–311, Hammond (1989), pp.207–16.
66 Burne (2002), pp.xix–xx, Delbrück (1920), Sabin (2007a), pp.11–15.
67 Sabin (2007a), especially pp.xi–xxi, 29–32, 139–43, 221–5.
68 Salt (2008).
69 Doubler (1994), Marshall (1947, 1988), Rowland (2006), Stouffer et al. (1949).
70 Sabin (1996a, 2000a, 2007b).
71 Erdkamp (2007), pp.71–2, 93, 219–20, Gabriel (2008), pp.72–5, Griffith (1987), Ch. 6, (1990), Chs 2–3, Sabin (1995), Zhmodikov (2000).
72 Liddell Hart (1999), p.229, Paret (1986), p.789.
73 Sabin (1993b), Sabin and Karsh (1989). For a simulation of the Iran–Iraq war, see Sharp (2003).
74 Sabin (1998a, 2002b, 2009a, 2009c, 2009d, 2010b).
75 Sabin (1996b, 2000b).
76 Handel (2001), Sabin (2007c).
77 On the history, see Chandler (1967), Part 17, Hamilton-Williams (1993), Hofschröer (1998, 1999), North (2000), pp.169–221. Games include Berg (1994), Chadwick (1975), Dalgliesh, Gutteridge and Gibson (1993), Miranda (2007a), Schutz (1962), Zucker (1983, 1985, 1986, 1998).
78 On the history, see Buckingham (2002), Ellis (1968), Hastings (2004), Kershaw (1990), Powell (1984), Ryan (1974), Wilmot (1952). Market Garden games include Billingsley (1990), Bomba (2006), Chadwick (1985), Emithill (1982b), Nelson et al. (1976), O'Connor (2003), Rinella (2003), Starkweather (2007),Tajima (2005). Games on the full campaign include Armstrong and Newhouse (2005), Balkoski (1986b), Bomba (1990b), Chadwick (1979), Edwards (1980), Herman (1986), Niles (1987), Pinsky (1965), Prados (2006), Taylor (1991b).
79 Bomba (1996), Holland (2003), Knipple (2008), Quarrie (1988), Stolfi (1992), von Borries (1977).
80 Bloom (1994), Griffith (2009), Kieser (1997), Macksey (2001), Marix Evans (2004), Robinson (2005), Sabin (2009a), pp.146–9, Schenk (1990). Published wargames on the subject tend to play down the impact of the Royal Navy in order to make the land campaign less one-sided. See Sandell and Lambshead (1985), Webb (1997), Werbaneth (1994) Young (1974).
81 Barker (1993, 2008), Dunnigan (1992), Ch. 9.
82 Caffrey (1990, 2000), Morgan (1986).

83 Biddle (2004), Dupuy (1979, 1992a, 1992b), Rowland (2006), Sabin (1993b, 1996b, 1998b, 2002b, 2003b, 2006b, 2009c, 2009d, 2010b).
84 Biddle and Friedman (2008).
85 Sabin (2010c).
86 Dunnigan (1992), pp.239–40, makes the same analogy.
87 http://groups.yahoo.com/group/lostbattles/.
88 Sabin and Mahaffey (2011); http://www.fifthcolumngames.co.uk.

Notes on Chapter 5

1 Perla (1990), pp.183–4.
2 Sabin (2010a), Vasey (2010b, 2010c).
3 Rubel (2006), p.127.
4 Creative Assembly (2004), Zampella et al. (2005), Smith et al. (2006).
5 Ascoli (1987), Baker (1986), Bey (2009c), Bonnard (2009), Gruber (1996), Kenyon and Ohlmeyer (1998), Olivier (2009b),Vasey (1995, 2008a, 2008b, 2009b, 2010b).
6 Allen (1975), Joslyn (1991), Rohde and Gillette (1983).
7 Bomba (2008), Desch (1998), Glantz and House (1999),Goldberg (1980), Hall and Malin (1981). The historical battle is better simulated in this case by games which focus their maps on the actual attack areas, such as Miranda (2010d), Romero (2009), Yamazaki (1992).
8 Adkin (2008), Curran (1975), Hall (2003), Martin, Cluck and Taylor (1989), Taylor (1988).
9 Butterfield (1979, 1983a), Hardy et al. (1975), Hill and Chadwick (1977), Yeghicheyan (1998).
10 Knight (1991), Taylor (1980).
11 Adkin (2005), Dupuy (1992a), Ch. 9, Frieser (2005), Lanchester (1995), pp.38–42.
12 Barker (1993), Featherstone (1988), Gibbs (1988),Werden (1978), Wyatt (1973).
13 Barker and Bodley Scott (1993), pp.29–35.
14 Curry (2008a, 2008b).
15 Maddox et al. (2002), O'Connor (2003, 2006), Smith (2009b), Špánel et al. (2007), Stahl et al. (2004, 2006), Tiller (2004).
16 Balkoski (1986a), Dunnigan (1976a), Markham (2007), Miranda (2002a), Raicer (2002), Vasey (2008b). Young and Orbanes (1972) is a fascinating dual simulation of the 1812 campaign in Russia, either with areas or with well over ten times as many hexes.
17 Berg (2002), Curry (2008a, 2008b), Faust (1992), Miranda (2002a, 2005, 2007b, 2010b), Nord (2005 and 2009), Roberts (1958), Schutz (1964).
18 Dunnigan and Nofi (1990), RFCM Team (1999, 2001), Sabin (2007a), Sabin and Mahaffey (2011).
19 Roberts (1958).
20 Before computer assistance, some use was made of brick-like grids of offset rectangles, which had the same basic properties as hexagons but were easier to draw.
21 Dunnigan and Winter (1986).
22 Price (1973).
23 Taylor (1982).
24 Miranda (1996a), Prados (1983). The problem can be mitigated somewhat by showing nearby hexsides as blocked to reflect the impact of straits or fjords, as in Boylan (1995) and Essig (2007).

25 Balkoski (1986b, 1987), Gross (1984), Knight (1993).
26 Dunnigan (1992), pp.15–19.
27 Raicer (2004a), Simon (2007).
28 Allen (1981, 1987), Guenette (2010), Olivier (2009c), Rinella (2003), Stahler and Greenwood (1993), Thompson (2010).
29 Euzet (2010), Gentil-Perret, Olivier and Valentin (2006), Young and Evans (2003).
30 Edwards (1985), Hamblen (1977), Miranda (1996b).
31 Butterfield (2009a), Wood and Dempster (1969).
32 Boylan (1995), Rowland et al. (1996).
33 Berg (2006), Chadwick (1989), Coatney (1984), Herman (1993), Markham (2003a), Markham and Seaman (1987), Ruhnke (2001), Simonitch (1996).
34 Chadwick (1982), Vasey (1995, 2008a).
35 Freeman (1999).
36 In Imbach (2005), Jackson (2008) and Martin (2009, 2010), the hand-drawn areas approximate almost entirely to regular hexagonal or square grids in any case.
37 Pratuch (1979).
38 Adkin (2001), Balkoski (1986a, 2005), Davis (1983), Doubler (1994), Ch. 2, Zucker (1985).
39 For exceptions in which rivers run within a chain of zones, see Edwards (1977), Sabin (2007a), Zimmerer (1985).
40 Chadwick (1989), Marsh (1997), Mulholland (2008), Ruhnke (2001).
41 Allen (1981), Guenette (2010).
42 Dunnigan (1975b). Bomba (1994) and Ritchie (1986) are both detailed simulations of the Eastern Front in World War Two, but where the former includes lots of individual rail lines, the latter includes none at all.
43 Schroeder (1997) gives each hexside its own distinct terrain type, as represented in a diamond with its ends at the centres of the two adjoining hexes, but this idea has not so far caught on elsewhere.
44 Miranda (1996b), Nofi and Isby (1978), Raicer (2004a).
45 For multiple terrain types, see Butterfield (1983a) and Starkweather (2007).
46 Allen (1987), Greenwood (1989), Hausrath (1971), pp.115–7, Rinella (2003), Stahler and Greenwood (1993), Guenette (2010), Vasey (2008b).
47 Chadwick (1989), Gross (1984), Hardy (1975), Kanterman and Bonforte (1976), Rowland (1996), Zocchi and Miranda (2007).
48 Berg (1978, 2005a), Davis and Curran (1982), Griffith (1998), Markham (1993), Poulter (1994), Sundell (2002).
49 Bomba (1994, 2007). The original game had 900 unit counters!
50 Bomba (1988a, 1989, 1990a), Dunnigan and Bomba (2008), Raicer (1994).
51 Balkoski (1986a), Davis (1983), Dunnigan (1971b).
52 Dunnigan (1970) and Hill (1980a) are classific tactical games using fire combat to extend defensive coverage.
53 Schettler (1994).
54 Ibid., p.22. Desch (1994).
55 Best and Essig (2002), Dunnigan (1972b), Miranda (2002b), Yamazaki (1993, 2007).
56 Glantz (2005), Maps 1.3, 1.4, Ritchie (1986), Zimmerer (1985).
57 Miranda (1990).
58 Desch (1992), Dunnigan (1992), pp.48–52, Georgian (1975a, 1975 b).
59 Zimmerer (1985) tries to avoid the problems of both ZOC and non-ZOC systems by allowing units to react and physically move into the path of enemies trying to

bypass them. Pratuch (1981–2) shows how lower level tactical boardgames using long-range fire rather than ZOCs tally much better with real military doctrine.

60 For direct simulation of multiple unit types, see Gross (1994), Prados and Greenwood (1981) and Rowland (1996). For a more focused approach, see Balkoski (1986a), Dunnigan (1973b) and Hessel (1985).

61 Taylor (2004), pp.72–80, 125.

62 Chadwick (1989), Davis and Curran (1982), Gross (1984).

63 Billingsley (1990), Bomba (2006), Butterfield (1983a), Chadwick (1979, 1985), Emithill (1982b), Nelson (1977), Rinella (2003), Schettler (1993), Starkweather (2007),Tajima (2005).

64 Dunnigan et al. (2009), Hamblen (1977), Knight (1991, 1992), Simo (2009),Taylor (1980, 1982), Webster (1992, 2003), Zocchi and Miranda (2007).

65 Dunnigan (1976a, 1979a), Sabin (2007a).

66 Hessel (1985), Niles (1987).

67 Butterfield (2009a), Edwards (1977).

68 Berg et al. (1977), Section III, MacGowan (1988), MacGowan, Thomson and DeNardo (1987), Mahaffey (2010), Sabin and Mahaffey (2010),Werbaneth (2006).

69 Williams and Oleson (1978) have a beautiful but very unclear map, while in Wimble (1996), the counter graphics are so overwhelming that they make it hard to read the unit details.

70 Balkoski (1987), Mulholland et al. (1977).

71 Balkoski (1986a, 1986b), Dunnigan et al. (1975).

72 Berg et al. (1977), Section VIII, and Simonsen (1976) provide a much fuller directory of symbols and of common terms used in wargaming. See also Dunnigan (1992), pp.66–86. The French magazine *Vae Victis* is renowned for the full-colour counter illustrations in its included games. Occasional wargames like Reed (1980) and Train (2011) use period unit symbols rather than NATO ones, but this tends to confuse as many players as it impresses.

Notes on Chapter 6

1 Adkin (2001), Section 9, Hall (2003), Goldsworthy (2001), pp.109–51, Glantz and Orenstein (2003), Appendix 10.

2 Balkoski (1986b), Butterfield (2009a), Chadwick (1979), Herman (1985), Southard (1986).

3 De Wilde (2005), for instance, simulates the Lvov-Sandomierz operation of 1944 in ten five-day turns, but does not really capture the way in which the Soviet offensive achieved most of its success during the first two weeks. See Orenstein (1996), Seaton (1990), pp.444–50.

4 Jackson (1975).

5 Gross (1984), Prados and Greenwood (1981).

6 Yamazaki (2007), Zucker (1985).

7 Berg (1996), Dunnigan (1981), Emithill (1982c), Essig (2006), Herman (1985), Southard (1986).

8 Engels (1978), pp.153–6. Yamazaki (1993) is absurdly optimistic when he allows infantry divisions to march along roads at 100 miles per day (eight 10 km hexes in each twelve-hour turn).

9 Bellamy (1990), p.197.

10 Berg (2005a), Cook (1987), Davis and Curran (1982), Dunnigan (1971c, 1976b), Markham (1993), McLaughlin (1980), Resch (2007).

11 Berg (2005b), Knight (1993), Niles (1987).
12 Sabin (2007a), Chs 3 and 5.
13 Bell (1992), Chadwick (1982), Dunnigan (1976b).
14 Cook (1987).
15 Chandler (1967), Ch. 16, Dunnigan (1971a), Hardy et al. (1975), Schettler (1994), Zucker (1985).
16 Balkoski (1986a, 1986b), Rinella (2003), Train (2011). Bell (1992) goes to the simple extreme of allowing units to march unlimited distances outside enemy contact in each monthly turn, but Ericson (1994) shows the artificialities this can create.
17 Morgan (1990b), Nelson (1977), Starkweather (2007).
18 Butterfield (1983a), Parker (1994).
19 Dunnigan (1976b), Resch (2007), Ritchie (1986), Smith (1983), van Creveld (1977).
20 Berg (1978, 2005a, 2006), Chadwick (1989), Davis and Curran (1982), Dunnigan et al. (2009), Hamblen (1977), Hardy (1975), Knight (1992), Schutz (1964), Taylor (1981a, 1982), Vasey (1995, 2008a), Zocchi and Miranda (2007).
21 For attempts to overcome this problem, see Raicer (2004a) and Rinella (2003).
22 Berg (2005b), Bomba (2007), Jackson (2008), Sabin (2007a), Yamazaki (2007).
23 Alexander and Gibbs (2001), Allen (1981, 1987), Balkoski and Donaldson (1979), Benninghof (2001), Hill (1980a), Nakamura (2008), Nord (2005, 2009), Stahler and Greenwood (1993), Zimmerer (1985).
24 Dunnigan (1976a), Velicogna (2009).
25 Balkoski (1986a), Balkoski and Donaldson (1979), Dunnigan and Winter (1986), Hill (1980a), Nelson (1977), Prados (1978), Starkweather (2007).
26 If using locking ZOCs, the encircling forces only need two units in opposite hexes to contain the encircled troops, just as unit G is pinned in Figure 5.2. This is a major advantage of the ZOC system.
27 Bellamy (1990), Biddle (2004), Biddle et al. (1991), Dupuy (1979, 1992a), Rowland (2006), Sabin (2007a).
28 In my *Lost Battles* system, up to twelve units may occupy a given zone, but only between three and five of them may fight at any moment, and the first unit fights with doubled effectiveness. See Sabin (2007a), pp.46–8.
29 Baggett and Grace (2009), Chadwick and Hay (1988), Dunnigan (1992), Ch. 4, Dunnigan et al. (1975), Emithill (1982a, 1982b), Hardy et al. (1975), Miranda (2007a), Nelson et al. (1976). In recent Folio Games such as Ritchie and Harvey (2010), the prohibition on stacking units is compounded by very weak ZOCs, making it ridiculously difficult for armies to concentrate or disperse beyond the Procrustean average of one unit per frontline hex.
30 Berg and Herman (1999), Nagel (2005), Smith and Hendrick (1980), Taylor (1981b).
31 For more realistic penalties for overcrowding, see Benninghof (2001), Berg (1978), Hill (1980a) and McLaughlin (1980). On stacking rules in general, see Sheikh (2008).
32 For boundary- rather than zone-based combat limits, see Chadwick (1982), Coatney (1984) and Koenig (2010).
33 Berg et al. (1976), Dunnigan (1971a), Dunnigan et al. (1975), Hardy et al. (1975), Mulholland et al. (1977), Schettler (1994), Zucker (1985).
34 Bomba (1994, 2007), Glantz (2001), Sariego (2003, 2006), Smith (1992a), Yamazaki (1992).

35 Benninghof (2001), Hill (1980a), Salt (2008). Systems that do try to take account of the limited availability of ammunition (especially artillery shells) include Butterfield (1983a), Davis (1983), Isby (2004) and Smith (1988).
36 Ashworth (1980).
37 Patrick (1972).
38 For a controversial exception in which hypothetical Cold War naval combat was modelled using retreats rather than damage results, see Dunnigan (1975c), McGuire (1976b) and Raine (2008).
39 Isby et al. (1976). This game avoids the worst excesses of the ‘alternate hex defence’ tactic by allowing victorious attacking units to advance in any direction instead of just dogging the footsteps of their retreating adversaries.
40 Sabin (2007a), Wargames Research Group (1973).
41 Desch (1992), DeWitt (1979), Dunnigan (1992), pp.48–52, Dunnigan et al. (1975), Georgian (1975a, 1975 b), Hardy et al. (1975), Nelson et al. (1976), Zucker (1985), Zucker, Dippel and Werth (1999), Zucker et al. (1975).
42 Dunnigan (1976a), Mulholland et al. (1977), Parker (1994), Ritchie (1986).
43 This also applies to miniature figures, which helps to explain why Barker and Bodley-Scott (1993) employ minor retreats as their only non-catastrophic combat outcome in pre-gunpowder land battles. Since I instead use a grid system to simulate such engagements, the precise positioning of the figures is less critical, and hence I can disorder each unit slightly to indicate a more appropriate and enduring transition from ‘fresh’ to ‘spent’ status. See Sabin (2007a).
44 Allen (1981, 1987), Chadwick (1982), Morgan (1990b).
45 Bomba (1988a, 1989, 1990a, 1992, 1994), Jackson (2008).
46 Davis (1983), Gross (1984), Isby (1977), Ritchie (1986), Morgan (1986), Zucker (1983).
47 One microgame that does nevertheless use incremental damage markers is Tajima (2005).
48 Biddle (2004), Dupuy (1979, 1992a), Lanchester (1995).
49 Lepingwell (1987).
50 Amador (1992), Berg et al. (1977), pp.42–50.
51 Benninghoff (2001), Chadwick (1993),Hill (1980a).
52 Dunnigan (1971a), Roberts (1958), Schutz (1962, 1963, 1964).
53 Dupuy (1992a), Ch. 4, Mearsheimer (1989).
54 Dunnigan et al. (1975), Isby et al. (1976), Nelson et al. (1976).
55 Wargames without CRTs include Allen (1981, 1987), Berg (2002), Chadwick (1982, 1989), Greenwood (1989), Hamblen (1977), Herman (1993), Raicer (2004a, 2004b), Sabin (2007a), Sariego (2003, 2006), Simonitch (1996), Stahler and Greenwood (1993), Taylor (1988) and Vasey (2008a). An interesting case study of the design calculations involved is Ferrell (2005).
56 Bomba (1994), Nofi (1976).
57 Berg (1994), Starkweather (2007).
58 Dunnigan et al. (1975), Smith (1992b).
59 Davis (1983), Isby et al. (1976), Sabin (2007a), Zucker (1985).
60 Games with especially ‘busy’ unit counters include Dunnigan (1975c) and Morgan (1986).
61 O’Connor (2003, 2006).
62 O’Connor (1985).
63 Pinsky (1965), Schutz (1962, 1963).
64 Graber (2008), Gury (2009), Miranda (2010d).

65 Taylor (1981b, 1982). Problems arise if one wishes to calculate fleeting firing opportunities in the middle of a move rather than at the end, since this requires dividing moves into increments as suggested in Morgan (1986), p.16.
66 Simple games such as Isby et al. (1976) often fail to include such strategic movement bonuses, and so create the paradox that a unit can expend all its movement points moving up to an enemy unit, launch a successful attack, and then advance after combat further than it could have reached had it faced no opposition whatsoever!
67 Chadwick and Hay (1988) allow infantry to make an occasional one hex advance before attacking, so as to soften the impact of this problem.
68 Bomba (2007, 2008), Chadwick (2009), Dunnigan and Bomba (2008), Yamazaki (2007). In Smith (1992a), movement and combat phases occur in an entirely random order.
69 Dunnigan (1971b).
70 Dunnigan (1973a, 1973b, 1976a, 1976b), Edwards (1977), Essig (2006, 2007),Prados (1995).
71 Berg (1977), Hardy (1975).
72 Balkoski (1986a, 1986b, 1986c, 1987), O'Connor (1985), Ritchie (1986).
73 Allen (1981, 1987), Benninghof (2001), Bull (2004, 2005),Greenwood (1989), Ritchie (1994), Smith (1984), Stahler and Greenwood (1993), Starkweather (2007), Wargames Research Group (1973).
74 Berg (2005b), Berg et al. (1976), Chadwick (2009), Hardy et al. (1975).
75 Engels (1978), Lynn (1993), Roth (1999), Thompson (1991), Sinclair (1992), van Creveld (1977).
76 Berg (1979), Campbell (1980), Pratuch (1980).
77 Barton (1973).
78 Engels (1978), Lynn (1993), Roth (1999), van Creveld (1977), Chs 1–3.
79 Chandler (1967), Part 14, Handel (2001), Map 1, van Creveld (1977), Ch. 2.
80 Berg (1977, 1978, 1985, 2005a), Davis and Curran (1982), Markham (1993), McLaughlin (1980), Palmer (1980a), Young and Orbanes (1972).
81 Plutarch, *Crassus* 20–8, Sabin (2007a), pp.203–7.
82 Davis (1983), Sabin (2007a), pp.44–5.
83 Herman and Berg (2007).
84 Sinclair (1992), Thompson (1991), van Creveld (1977), Chs 3–7.
85 Bomba (2008), Raicer (2001). In Dunnigan and Bomba (2009), this simple approach is supplemented by an even simpler rule that stipulates that all Soviet units automatically become unsupplied from turn six onwards, to reflect their offensive running out of steam!
86 Bomba (1989, 1994, 2007), Dunnigan (1976b), Dunnigan and Bomba (2008), Glantz (2001), Kershaw (2000), Raicer (2004a), van Creveld (1977), Ch. 5, Yamazaki (2007).
87 Beevor (1999), Bomba (1988b), Dunnigan (1971b), Edwards (1977), Graber (1997), Hoyt (2001).
88 Hayward (1998), van Creveld (1977), Chs 6–7.
89 Greene and Massignani (1998), Moulton (1978).
90 Graber (2008), Knight (1993).
91 Berg (1996), Emithill (1982c), Niles (1987).
92 Hastings (1987), Jackson (1975).
93 Balkoski (1986c), Dunnigan (1971b, 1971d, 1972a, 1981), Essig (2006), Miranda (2010c), Southard (1986).
94 Zucker (1985), p.14.

95 Dunnigan (1992), p.114.
96 Balkoski (1986a, 1986b, 1986c, 1987), Miranda (2000), Schettler (1991).

Notes on Chapter 7

1 Schutz (1962).
2 Taylor (1988).
3 McGuire (1976a).
4 Dunnigan (1992), pp.87–8, Sabin (2002a).
5 Allen (1987), Perla (1990).
6 Keegan (1987), van Creveld (1985).
7 Croxton (1991), Farcau (1988), Perla (1990), Ch. 7.
8 Besinque (1987), Patrick et al. (1972, 1991).
9 Dunnigan (1979b), Kirschenbaum (2010), O'Connor (2003, 2006), Sanders (1982).
10 Sabin (2007a), Ch. 5, Conclusion, (2010a).
11 Berg (1994, 2006), Verssen (2008, 2009).
12 Davis (1978), Dunnigan (1973b).
13 Jervis (1988).
14 Dunnigan and Benninghof (1994), Euzet (2010).
15 Berg (1997), Heinze (1977), Markham (2003c), Rowland and Pinder (1984).
16 Calhamer (1976).
17 Curry (2008a), O'Connor (2003, 2006), Rapier (2008), Tilley, Rowland and Pearce (2004).
18 Fadok (1995), Ch. 3.
19 Messenger (1991), Ministry of Defence (2001), Ch. 3.
20 Moffat (2000).
21 Raicer (2007) saves time by having the players take their turns simultaneously on opposite fronts, before swapping over.
22 Clarke (2009), Hughes (2010a), p.14.
23 Wargames Research Group (1973).
24 Davis (1981), Prados and Greenwood (1981).
25 Smith (2009a), Tarrant (1992), Chs 4–7.
26 Butterfield (1983a), Hill (1980a), Smith (1988).
27 Cook (1987), Desch (1994), Isby et al. (1976), Mulholland et al. (1977), Nelson et al. (1976), Yamazaki (1993).
28 Rapier (2009), Salt (2009).
29 Chadwick (2009), Simonitch (2009), Yamazaki (2007).
30 Sabin (2007a), pp.68–9.
31 Knight (1991), Smith (1992b).
32 Benninghof (2000), Berg (1978), Brimmicombe-Wood (2006), Dunnigan (1973d, 1975d), Hind (1980), Kisner (1992), Taylor (1980, 1981b).
33 Markham (1992) uses simple generic orders for each part of the battle line, but these orders leave a lot of options open.
34 Each unit may normally only be activated in one impulse per turn, but in Nakamura (2006) and Starkweather (2009), units may be activated successively by each headquarters in range, which produces some unrealistic effects when headquarters are concentrated or units are shuttled from one to another.
35 Berg (1994), Hill (1980b), Train (2011).
36 Vasey (2010c), Walker (1995).

37 Berg (2005b), Herman and Berg (2007), Hill and Hail (1986), Smith (1984), Starkweather (2007).
38 Allen (1981, 1987), Greenwood (1989).
39 Benninghoff (2001), Eickert (2008).
40 Miranda (2000), Schettler (1991).
41 Besinque (1987), Patrick et al. (1972, 1991), Pitcavage (1996).
42 Clausewitz (1976), pp.101, 217.
43 Taylor (2010), Vasey (2010a).
44 British Army (1884), Hausrath (1971).
45 Galloway (1981), Grainger (1990).
46 *Battles*, 3 (2010), Palmer (1977, 1980b).
47 Glynn (1972), Pitcavage (1996), Setear (1988).
48 Raicer (2007).
49 Karp (1984), Zucker (1986).
50 Cook (1989), Young and Evans (2003).
51 Besinque and Dalgliesh (1991), Dalgliesh, Gutteridge and Gibson (1993).
52 Churchman (1982), Dunnigan (1975a), Raicer (2004b). Brewster, Dalgliesh and Gutteridge (1972) use a combination of blocks, dummies and written orders to conceal enemy dispositions.
53 Gray (1977), Wiseman and Greenwood (1975).
54 Chadwick (1984, 1985),Knight (1983).
55 Clark (1978), Greene (1979), Lauer (1979), McDonald (1979).
56 Bomba (1994), Dunnigan (1976a), Yamazaki (2007).
57 Berg (1978), Hardy (1975), Hodges (2009), Smith (1992a).
58 Berg (2006), Herman (2008), Nakamura (2008), Prados (2007), Rooker (1994).
59 Borg (2009), Clausewitz (1976), pp.86, 217, Herman (1993), Raicer (1999, 2002), Vasey (2008a).
60 Coatney, Hoffman and Poulter (1984), Guillory (2009).
61 Knight (1992), Taylor (1981a, 1991a).
62 Sabin (2010a).
63 DeWitt (1977), Young (1975).
64 Anderson (1986), Wiseman and Greenwood (1975).
65 Vasey (2010b, 2010c).
66 Doel (2004).
67 Sabin (2007a), pp.69–71, (2009e), Sabin and Mahaffey (2011).
68 Chadwick (1979), Dunnigan (1972c), Ritchie (1993).
69 Hamblen (1977), Smith (2000).
70 Bomba (1988b), Bomba and Hessel (2002), Essig and Yamazaki (1996).
71 Pulsipher (2010).
72 Bennett (1979), Brookes (1975), Ch. 9, Foot (2004), Hesketh (1999).
73 Morraglia and Naud (2010), Prados (1994), Vinal (1995).
74 Balkoski (1986b), Edwards (1980), Essig (2005), Pinsky (1965), Rident and Le Quellec (2009).
75 Bomba (1990b), Herman (1986), Knight (1993), Niles (1987).
76 Borg (2009), Dunnigan (1972d, 1973b, 1973d, 1975d), Hardy (1977).
77 Berg (1978, 2005a), Davis (1978), Davis and Curran (1982), Markham (1993), Vasey (1995, 2008a).
78 The player must still, of course, operate the game mechanics and apply the tactics laid down in the rules for that side.
79 Published solitaire games of tactical ground combat, such as Klug (1987) and Smith and Butterfield (1983), often rely instead on programmed paragraph

systems that are less replayable once the secrets have been discovered. For exceptions, see Hull (2008) and Shelley (1987).

80 Aceto (2009), Burtt, Einhorn and Wilson (2002), Swan (1990); http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/consim.aspx.

81 Alexander and Gibbs (2001), Butterfield (2009b), Chadwick (1992), de Vandiere (2010), Dunnigan (1974a), Gibbs (1988), Graber (2000b), Joslyn (1991), Markham and Seaman (1987), Rohde and Gillette (1983), Verssen (2008, 2009). In Gentil-Perret, Olivier and Valentin (2006) and Herman (1991), AI control actually switches to whichever side is on the defensive at the time.

82 Graber (1997), Markham (2003b), Southard (1993), Yegicheyan (1999), Young and Miranda (1996).

83 Dixon and Rife (2008), Frank (1983), Goodchild (1992), Graber (2000a, 2006), Hodges (2009), Knight (1996), Miller (2005, 2010), Southard (1988), Verssen (1991a, 1991b, 2010).

84 Butterfield (2009a). Both Brimmicombe-Wood (2006) and Butterfield (1983b) rely on much more complex planning and limited intelligence rules to achieve similar effects in two-player simulations.

85 Dunnigan (1974b), Miranda (2010a), Southard (1990).

86 Bomba (1991), Knight (1992).

87 Southard (1987).

88 Miranda (2009a).

Notes on Chapter 8

1 Dunnigan (1992a), p.13.

2 Sabin (2002a), p.193.

3 British Army (1884), Curry (2008a, 2008b), Perla (1990).

4 Rubel (2006), pp.119–20.

5 Sabin (1993a, 1994a).

6 Sabin (1994b, 1997, 2003a, 2006a, 2007a).

7 Clemente and McMillan (1976) boast that their combat system involves no dice or cards, but it does involve simultaneous choices by the opposing players, which have the same overall effect. See also Train (2011).

8 Clausewitz (1976), p.101.

9 Ibid., p.119.

10 Ibid., p.86.

11 Pulsipher (2010).

12 Overy (1995), Showalter and Deutsch (2010).

13 Sabin (2009a).

14 Dixon and Rife (2008), Frank (1983), Graber (2009).

15 Dunnigan (1975b), Prados and Greenwood (1981), Rowland (1996).

16 Davis (1981), Dunnigan (1975e), Niles (1985), Nofi (1976), Young and Evans (2003).

17 Hardy (1975), Markham (1993, 2003c), McLaughlin (1980).

18 For example, Bomba (1989, 1994, 2007) gives German players in his simulations of Operation Barbarossa the options of halting for three weeks to rebuild their supply arrangements (as advocated by von Paulus) or of replacing the historical broad front approach by a more focused drive on Moscow (as urged by Halder). See Boog et al. (1998), pp.275–6, 569–94.

19 Nordling (2010a), Sabin (2010a).
20 Bomba (1988b), Bomba and Hessel (2002), Essig and Yamazaki (1996).
21 Axworthy (1995), Dunnigan (1971b, 1976b), Dunnigan and Bomba (2008), Edwards (1977), Miranda (2009b), O'Connor (1985), Ritchie (1986), Yamazaki (2007), Ziemke (2006), Ch. 10, Zimmerer (1985).
22 Blennemann (2002), Chandler (1967), Chs 37–8, Glantz (2008), Ch. 4, Hind and Poulter (1993), Markham (2007), Nakamura (2006), Ritchie (1980, 1993), Yamazaki (2003).
23 Bomba (1988a, 1989, 1994, 2007).
24 Dunnigan (1979a), Dunnigan and Bomba (2008).
25 Beyma (2010).
26 Chadwick (1992, 2009), Cundiff and Bishop (2009).
27 Sabin (1996a, 2007b).
28 Barker and Bodley-Scott (1993), Barker, Bodley-Scott and Laflin-Barker (2001), Borg (2009), Sabin (2007a), pp.12–15, 71–3.
29 Simonitch (1996), Zucker (1998).
30 Chadwick (1986), Gross (1984).
31 Bidermann (2000), Chs 10–11, Brooks (1996), MacDonald (1973), Ungváry (2003).
32 Bomba (1985, 1993), Dunnigan and Benninghof (1994).
33 Bell (1992).
34 Berg and Herman (1999), Isby (1977), Knight (1991).
35 Adkin (2008), Martin and Millman (1989), Perello (1992), Smith (1992a), Taylor (1988).
36 Raicer (1994, 2004a).
37 Perla (1990), p.183.
38 http://www.decisiongames.com.
39 Chadwick (1991, 1992). Isby (1977).
40 Euzet (2010), Jackson (1980), Nakamura (2006), Rinella (2010), Smith (1984).
41 Rident and Le Quellec (2009), Smith (1988), Taylor (1988, 1991a, 1991b).
42 Rinella (2010), Tajima (2005).
43 In Dunnigan (1976b), the rules extend to more than 60 separate sections.
44 Isby (1977).
45 Sabin (2007a), Appendix 1.
46 Dixon and Rife (2008).
47 Sabin (2007a).
48 Balkoski (1986b), Brimmicombe-Wood (2006), Butterfield (1983a), Chadwick (1979, 1991), Davis and Curran (1982), Dunnigan (1972c), McLaughlin (1980).
49 Benninghof (2001), Berg (1994, 2005b), Berg et al. (1976), Best and Essig (2002),Dunnigan et al. (1975), Hardy et al. (1975), Smith (1992a), Zucker et al. (1975).
50 For instance, in Nelson et al. (1976), the ground scale varies from 500 to 2000 metres per hex between the four individual games, thereby creating gross variations between the length of front that the battalion-sized units are able to hold. See also Dunnigan (1973b).
51 Brimmicombe-Wood (2006), Rident and Le Quellec (2009), Sabin (2007a), Ch. 6, Simonitch (2009), Starkweather (2007, 2009), Verssen (2009 and 2010).
52 In the recent 'Fire & Movement' Folio games such as Ritchie and Harvey (2010), there is a glaring contradiction between rule and example over the extra cost for leaving enemy ZOCs, but here it is the rule that is misleading and the example that is more accurate.

53 Games with extensive commentary include Hill (1980b), Radey (1982), Reed (1980) and Starkweather (2007).
54 Sabin (2007a).
55 Balkoski (1986a, 1986b), Miranda (2006a, 2006b).
56 How best to play particular wargames is also a staple topic of hobby magazines such as *The General*.
57 Berg et al. (1977), pp.56–88, 110–17. In some early wargames such as Schutz (1962, 1963, 1964), the designer was not even named anywhere within the entire package. The resulting problem of attribution is discussed in Campion and Patrick (1972), pp.12–13.
58 Sabin (2003c, 2007a).
59 Perla (1990), Rubel (2006).
60 Haggart (1978a, 1978b, 2005, 2006a, 2006b). Quote from 2006b, p.32.
61 Vasey (2010b).
62 Barnard (1979, 1981), Best (1984), Koontz (1977).
63 Haggart (2005), p.20.
64 Klein (1985).
65 Vasey (2010a, 2010b, 2010c).
66 For a more generic approach involving eight possible tests, see Haggart (2006b).

Notes on Chapter 9

1 Starks (1977). Where his imagination failed is that he suggested that such a monster game could be bought for under $1000, only 100 times as much as real wargames of the time.
2 http://www.iaa.bham.ac.uk/research/projects/manzikert/medievalwarfare.shtml, Haldon et al. (2010).
3 Pulsipher (2010).
4 Sabin (2009e), Sabin and Mahaffey (2011).
5 Sabin, van Wees and Whitby (2007), Vol. I, Part II.
6 Lancel (1995), Warmington (1960).
7 Mills and Sabin (2008).
8 Sabin (2007a).
9 Daly (2002), Goldsworthy (2001).
10 Sabin and Mahaffey (2011); http://www.fifthcolumngames.co.uk.
11 Sabin (1996a, 2000a, 2007b).
12 For different views of how infantry combat might have looked in the specific case of duels between Greek hoplites, see Goldsworthy (1997) and Luginbill (1994).
13 There are many hundreds of magazine-published wargames, including a few one-off editions such as Griffith (1982).
14 Dunnigan (1992), Ch. 1.
15 Freeman et al. (1980), Ch. 4, Palmer (1977).
16 Sabin (2007a).
17 Sabin and Mahaffey (2011).
18 For a report on an even larger ‘megagame’ on this conflict, see Grainger (1990). More conventional two player wargames on the conflict include Hardy (1975), Kidd (1983), Simonitch (1996) and Sutcliffe (1991).
19 Cornell, Rankov and Sabin (1996), Goldsworthy (2000), Lazenby (1978).
20 Carlton (1992), pp.260–2.
21 Lazenby (1978), Ch. VI.

22 Gabriel (2008), Lancel (1998).
23 Other wargames on Hannibal's Italian campaign include Berg (2003), Hollinger (1983) and Sutcliffe (1994).
24 Mills and Sabin (2008).
25 Sabin (1996a, 2007b, 2007c).
26 Lazenby (2004), Thucydides, I.143 and V.64–5.
27 Lazenby (1978), Polybius, III.89–90.
28 Hammond (1989), p.69, Hanson (1989), Kagan (1974), Chs 2–3, Leach (1978), pp.201–3, Thucydides, II.21–2, 59–65.
29 Goldsworthy (2000), Chs 7–8, Lazenby (1978), Ch. III.
30 Berg (1977, 1984, 1985, 2003, 2005a), Hollinger (1983), Kuhlmann and Iwamasa (2006), Newberg (1982), Poulter (1994), Sundell (2002), Wiseman and Greenwood (1975).
31 Lazenby (1978), Ch. III.
32 Gaebel (2002), Polybius, III.117, Sabin (2007b), pp.422–9.
33 Scullard (1974), pp.154–62.
34 Berg (1977), Hardy (1975), Hollinger (1983), Newberg (1982).
35 Polybius, III.56, 71–2, 114.
36 Daly (2002), Lazenby (1978), Ch. III, Sabin (2007a), pp.179–85.
37 Goldsworthy (2000), pp.181–90, Lazenby (1978), pp.60–61.
38 Polybius, III.92–4.
39 On the skirmishes, see Polybius, III.65, 86.
40 Lanchester (1995), pp.47–9.
41 Sabin (1996a), pp.73–7.
42 Livy, XXII.3–7, XXIII.24.
43 My *Lost Battles* system uses very similar mechanisms to motivate outclassed armies to put up the best fight they can. See Sabin (2007a), pp.71–3.
44 On the famous question of whether Hannibal had any chance of taking Rome after Cannae, see Lazenby's remarks in Cornell, Rankov and Sabin (1996), pp.39–48.
45 http://visibleearth.nasa.gov/.

Notes on Chapter 10

1 Lazenby (1978), pp.84–5, (1996), pp.111–2, Man (2004), Marozzi (2004), Middlebrook (2001), p.263.
2 Featherstone (1962), pp.11–3, 23–4, Sabin (2002a), pp.209–10, 214–6. For more detailed moral reflections by wargamers, see Crowe (2009) and Schlesinger (1993).
3 Wells (1977), p.97.
4 Perla (1990), p.179.
5 Allen (1987), pp.99–101, Perla (1990), pp.178–9, Vasey (2009a).
6 Atkins (2009), Bohemia Interactive (2009), Smith (2010).
7 Hughes (2010b), Smelser and Davies (2008), Ch. 7.
8 Poniske (2010), p.16.
9 Cornell and Allen (2002), p.227.
10 Burtt and Miranda (1988), de Gunzbourg, A. (2008), Kane (1989), Kanger (2009), Karp (1984), Miranda (1991), Ruhnke (2010); *The Battle of Algiers*, at: http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/consim.aspx.
11 Beevor (1999), Glantz (2009).

12 Sabin (2002a), Schlesinger (1993).
13 Anderson and Bushman (2001), Anderson et al. (2003).
14 Cosmatos, G.P. (1985) *Rambo: First Blood, Part II*, Anabasis Investments NV/Buzz Feitshans.
15 Helferrich (1980), Hughes (2010b), Radey (1979, 1982, 1985), Reynolds (1997, 1999, 2002).
16 Bellamy (2007), Davies (2006), Ellis (1990), Gilbert (2000), Glantz and House (1995), Keegan (1989b), Mawdsley (2005), Murray and Millett (2000), Overy (1995, 1997), Showalter and Deutsch (2010),Weinberg (1994), Willmott (1989).
17 Ellis (1990, 1993),Overy (1994), Speer (1970), Tooze (2006).
18 Grigg (1980).
19 Zetterling and Frankson (2000) show that German losses during their brief offensive at Kursk were dwarfed by those they suffered during the continuing Soviet offensives over the following months.
20 http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/consim.aspx.
21 Sabin (1996b, 2009a).
22 Beyma (2002), Niles (1985), Prados and Greenwood (1981), Rowland et al. (1996).
23 Isby (1998), pp.192–5, Price (1998a), p.115.
24 Taylor (1982).
25 Dunnigan et al. (2009) and Zocchi and Miranda (2007) offer more abstract games on the entire US daylight bombing campaign, but their handling of fighter endurance is much less satisfactory, and they are still too complex for class use.
26 The origins of *Lost Battles* can be traced back through two editions of *Strategos*, and then via my earlier games *Legion* and *Phalanx,* all the way to my tweaks of a generic published game called *Battles* and eventually to an unpublished system that I designed over 30 years ago, building on games by Berg and by the Wargames Research Group. See Berg (1977), Sabin (1993a, 1997, 2003a, 2006a, 2007a), Taylor (1979b), Wargames Research Group (1971).
27 Grigsby et al. (1999).
28 See, for example, Boog, Krebs and Vogel (2006), Part I, Caldwell and Muller (2007), Freeman (2001), Isby (1998), Part 4, McFarland and Newton (1991), Price (1973).
29 Ethell and Price (1981), Middlebrook (1983). The book on Big Week by Infield (1974) is a much more impressionistic affair. Graber (2006) offers an interesting solitaire microgame on the traumatic Schweinfurt raids in August and October 1943.
30 Army Air Forces Historical Office (1945), pp.136–9, Bowman (2006), pp.118–22, Caldwell and Muller (2007), pp.161–2, Craven and Cate (1983), pp.41–3, Hammel (1993), pp.131–9, (1994), pp.253–4, Infield (1974), Ch. 12, Rust (1976), pp.14–5, Shores (1985), pp.186–7.
31 Ethell and Price (1981), pp.30–1, Fry and Ethell (1980), p.39, Hammel (1993), pp.131–8, McFarland and Newton (1991), pp.140–2, Price (1973), pp.116–7.
32 Taylor (1982).
33 Ethell and Price (1981), pp.10–11. Dunnigan et al. (1999) get their map scale spectacularly wrong when they claim that each hex is 33.3 miles across rather than the actual figure of around 20 miles.
34 http://visibleearth.nasa.gov/.

35 Caldwell (1998), pp.223–4, (1991), pp.225–6, Ethell and Price (1981), pp.10–11, Scutts (2001), p.58.

36 Stade, Deelen, Metz and Schleisheim were the headquarters of the 2nd, 3rd, 4th and 7th fighter divisions respectively. Ansbach was the main base for the twin-engined Me110 'destroyers', and Pontecchio was the central Luftwaffe control centre in northern Italy. Metz was some way inland from the airfields of the 4th fighter division, but it also abstractly represents the forward airfields of the 7th fighter division around Wiesbaden and the fact that one Gruppe of JG26 redeployed back to Trier to meet this attack. See Caldwell (1998), pp.221–2, Ethell and Price (1981), pp.16–20, 171–4, Hooton (1997), p.232, Shores (1985), p.180.

37 Zocchi (1971), Zocchi and Miranda (2007).

38 Pollard markers are normally separate counters placed underneath the unit counter to show its strength, as in Hind and Poulter (1993).

39 Compare, for instance, McFarland and Newton (1991), pp.103–6 with Craven and Cate (1983), p.49 and Boog, Krebs and Vogel (2006), pp.86–7. Detailed sources on the whole issue of US fighter range extension include Boylan (1955), Daneu (1996) and McFarland (1987).

40 Ethell and Price (1981), pp.30–1, Price (1973), pp.116–7.

41 Schmid (1954), Vol. II, pp.118–9.

42 Ibid. The 45-minute interval is confirmed by Army Air Forces Historical Office (1945), p.138. Bowman (2006), p.119 quotes an Eighth Air Force airman who spotted a column of smoke ahead at 1200, but if his timing were correct, this cannot have been from Regensburg as he supposed.

43 Caldwell (1998), pp.221–2.

44 Fry and Ethell (1980), p.39.

45 Caldwell (1991), pp.225–6, (1998), pp.221–2, Caldwell and Muller (2007), p.162. Schmid (1954), Vol. II, pp.118–21, gives a particularly telling account of the impact of the northern diversion.

46 Wyler, W. (1944) *Memphis Belle*, War Activities Commission.

47 Lanchester (1995), Chs 5–6.

48 Caldwell and Muller (2007), pp.161–7, Craven and Cate (1983), pp.41–8, Shores (1985), pp.186–8.

49 One Luftwaffe commander complained that excessive preoccupation with downing US bombers meant that, 'the safest flying that was ever possible was that of an American fighter over Germany'. See Air Ministry (2001), p.296, Sabin (2009a), pp.154–8.

50 Ethell and Price (1981), pp.21–2.

51 Caldwell and Muller (2007), p.161, Hammel (1994), pp.253–4. Since only two bomber units attack Regensburg from the south, the single escort unit is sufficient to give the Americans more chances of inflicting a hit than of receiving one, hence making continued attacks by the Me110s irrational.

52 Beevor (1999), Chuikov (1963), Glantz (2009), Tarrant (1992).

53 Buchner (1991), Glantz and House (1995), Chs 12–16, Mitcham (2001).

54 Zetterling and Frankson (2008), pp.153, 169–71.

55 Butterfield et al. (1979), Desch (2001), Gentil-Perret (2007), Radey (1979), Trout et al. (2003), Zoldak (2010).

56 Barnard (1980), Stanton, Murrell and Radey (1980).

57 Glantz and Orenstein (2003).

58 Nash (2005), p.280.

59 Zetterling and Frankson (2000, 2008).

60 Buchner (1991), Ch. 1, Carell (1970), pp.399–433, Orenstein (1991), Tsouras (1994b), Chs 33–4. See also Radey's account in Trout et al. (2003), pp.38–48.
61 Glantz and Orenstein (2003), pp.147–64, Nash (2005), pp.31–2, Trout et al. (2003), p.42.
62 Zetterling and Frankson (2008), pp.350–61.
63 Ibid., pp.322–61. Glantz and Orenstein (2003), pp.147–53, Nash (2005), Ch. 2.
64 Zetterling and Frankson (2008), pp.97–102, 117–8, 154.
65 Nash (2005), p.172, Zetterling and Frankson (2008), pp.222, 236.
66 Desch (2001), Gentil-Perret (2007), Zoldak (2010).
67 http://visibleearth.nasa.gov/.
68 Glantz and Orenstein (2003), pp.164–87, Zetterling and Frankson (2008), pp.129–30, 147–9, 158–68.
69 Biddle et al. (1991).
70 Dunnigan (1978), pp.139, 142–3.
71 Nash (2005), p.280.
72 Zetterling and Frankson (2008), pp.82–98.
73 Ibid., Ch. 7. Nash (2005), Ch. 5.
74 Zoldak (2010).
75 Nash (2005), Ch. 9, Zetterling and Frankson (2008), pp.112–5, 187–8.
76 Nash (2005), Chs 19–25, Zetterling and Frankson (2008), Chs 17–19.
77 Nash (2005), Chs 13–15.
78 Buchner (1991), pp.37–70, Carrell (1970), pp.417–33, Nash (2005), Chs 19–25, Zetterling and Frankson (2008), Chs 17–19. See also Radey in Trout et al. (2003), pp.46–7.
79 Hughes (2010), Smelser and Davies (2008).
80 Nash (2005), p.93, Zetterling and Frankson (2008), pp.25–9, 61–7.
81 Carell (1970), pp.400–4, Zetterling and Frankson (2008), pp.118–9.
82 Nipe (2000), Von Manstein (1987), pp.414–42. See also Radey in Trout et al. (2003), p.48.
83 Nash (2005), pp.167–9, Zetterling and Frankson (2008), pp.169–71.

Notes on Chapter 11

1 Barker (1993), British Army (1884), Curry (2008a, 2008b), Dunnigan and Hardy (1984), Morgan (1986, 1988), Perla (1990).
2 Games in which counters represent individual soldiers or aircrew include Chalk (1981), Dixon and Rife (2008), Dunnigan and Winter (1986), Frank (1983), Smith and Butterfield (1983) and Taylor (1983, 1984).
3 Featherstone (1962, 1970a, 1975, 1988), Gush and Finch (1980), Morschauser (1962), Quarrie (1980, 1987), Wise (1969); long-running magazines include *Miniature Wargames* and *Wargames Illustrated*.
4 Ahmed (2010), Armstrong (2009b), Halter (2006), Smith (2009b), Zampella et al. (2005).
5 Dunnigan (1972e, 1973e, 1973f), Reed (1972).
6 Hind (1980), Morgan (1986), Seaman (1995), Taylor (1980, 1993), Uhl (1987).
7 Isby (1977), Webster (1987, 1992, 1993, 1994, 2003).
8 Leonardi and Kaufman (1980), Taylor (1992).
9 Jones et al. (1998), Kawahito et al. (1998).
10 Air combat dynamics are discussed in Shaw (1986) and Spick (1983).
11 Kawahito et al. (2006), Tanner (1978), pp.80–2.

12 Price (1990), Shockwave Productions (2005).
13 Price (1979), pp.27–9, 40–3, 60–1, (1989a), Ch. 3, Spick (1983), Chs 3–5.
14 Aders (1979), Franks (1994), Hinchliffe (1996), Kawahito et al. (2002), Maddox et al. (2002).
15 Lead Pursuit (2005).
16 Comer (1993), p.125, describes four closely spaced German fighters being blown apart when they incautiously attacked a B-17 formation from behind, showing that such attrition was perfectly achievable if human self-preservation instincts failed for some reason.
17 Sabin (2007a), Sabin and Mahaffey (2011).
18 Bruffell (2008), Creative Assembly (2004), Erudite Software (1999), Slitherine Software (2005).
19 Atkins (2009), Bohemia Interactive (2009), Smith (2009b), Španěl et al. (2007).
20 Benninghoff (2001), Chadwick (1993), Eickert (2008), Hill (1980a), Hull (2008), Rumford and Marsh (1994), Tapio and Martin (2000), Wargames Research Group (1973). More tank-focused games include Dunnigan (1970, 1975d) and Hill and Hail (1986).
21 Moylan et al. (2004), Tiller (2007).
22 Chiodo et al. (2005), Stahl (2004), Wardwell et al. (2005), Young et al. (1996).
23 Dunn et al. (2004), Greenwood et al. (1985), Medrow (1986).
24 Memoir collections on the northwest European campaign of 1944–45 include Ambrose (1997), Neillands (1995) and Williams (2004). Doubler (1994) offers a useful overview of US tactics across the various battles of this campaign.
25 Brutton (1992), Daglish (2007), Ford (1989), Grace (2007), Jary (1987), Koskimaki (2003), MacDonald (1947), Saunders (2001), White (2001), Wilson (1987).
26 Borthwick (1994), Lincoln (1994), Macksey (1974).
27 Bull (2004, 2005), War Office (1944), Western Command (1942).
28 War Office (1944), p.53.
29 Grace (2007), p.97.
30 Ellis and Chamberlain (1976), pp.24–5.
31 Ibid. Macksey (1974).
32 This matchup is exactly in line with Daglish (2007), p.45.
33 Bull (2004), pp.23–9, Gander (1998), van Creveld (1983).
34 Bull (2005), p.7, Borthwick (1994), *passim*, Brutton (1992), p.57, Daglish (2007), Ch. 3, Lincoln (1994), pp.100–9, Saunders (2001), pp.58, 79, 101.
35 Wargames Research Group (1973), pp.2–3.
36 Rowland (2006), Fig. 3.3 shows how more numerous attackers routinely suffer heavier casualties.
37 Dunnigan (1978), pp.142–3.
38 For more complex line of sight rules involving different elevations, see Greenwood (1985) and Prados (1978).
39 Salt (2008).
40 Macksey (1974), pp.162–3, 174–7.
41 Bull (2007), Middlebrook (1978).
42 Biddle et al. (1991), Dunnigan (1978), pp.142–3, Nash (2005), pp.27–8, 69–71, Zetterling and Frankson (2008), pp.99, 345–6.
43 Smith (2005).
44 http://www.kcl.ac.uk/schools/sspp/ws/people/academic/professors/sabin/conflictsimulation.html.

45 Allen (1981), Balkoski and Donaldson (1979), Baslund (1985), Chiodo et al. (2005), Dunnigan and Winter (1986), Greenwood (1989), Guenette (2010), Hill (1973, 1980a, 1980b), Kane (1989), Nakamura (2008), Stahl et al. (2004, 2006), Tapio and Martin (2000), Walker (2008), Zampella et al. (2003, 2005).
46 Middlebrook (1994), pp.287–9.
47 Glantz (2009).
48 Allen (1981), Balkoski and Donalson (1979), Greenwood (1989), Greenwood et al. (1985), Nakamura (2008).
49 Hill (1980a), p.31.
50 Walker (2008) uses a similar square grid with separate roads in his Mogadishu game, but here the scale problem is even worse since each of his zones is supposedly 50 metres across.
51 War Office (1944), pp.86–95.
52 Bull (2005), p.36.
53 Kawahito et al. (1998), Shockwave Productions (2005).
54 Tiller (2004).
55 Overy (1980), Sabin (2009a).
56 Spick (1978, 1983, 1988, 1996, 2001).
57 Ethell and Price (1981), Price (1979, 1989a, 1989b, 1990, 1998b).
58 Franks (1992), Freeman (2001), Middlebrook (1983), Shaw (1986).
59 Isby (1998), Johnson (1956), Johnson and Caidin (1958), O'Leary (2000), Smith (1991).
60 Tactical games include Dunnigan (1973e), Seaman (1995), Taylor (1980, 1992) and Webster (1993, 1994). Operational games include Brimmicombe-Wood (2006), Butterfield (1983b), Knight (1996) and Taylor (1982).
61 The closest comparison is with the highly abstract tactical modules on Pacific air combat in Rohrbaugh (2005, 2008).
62 Middlebrook (1983), Ch. 7, gives a vivid example of such actions.
63 Bowyer (1974), Chs 9, 12, (2002), pp.72–5, Caygill (2001), Spick (1983), pp.73–7.
64 Bowyer (1974), Ch. 9, (2001), pp.72–5.
65 Ethell and Price (1981), pp.28–9, Freeman (2001), pp.35–44, Middlebrook (1983), pp.51–2, Price (1973), pp.64–5, 116–7, (1989b), pp.104–18, (1990), p.77.
66 Freeman (2001), pp.42–4, Price (1973), pp.64–5, (1989b), pp.110–8, Spick (2001), pp.22–30.
67 Price (1989b), p.117 shows a 'tucked-in' combat wing box with a frontage of just 950 yards.
68 Price (1989a), pp.103–5, Spick (1983), pp.38, 57–61.
69 Freeman (2001), pp.75–9, Price (1989a), Ch. 3, Spick (1983), Chs 4–7.
70 Freeman (2001), pp.66–9, 75–9, O'Leary (2000), Ch. 26. Price (1989a), p.117 shows twelve German fighters in three line abreast 'schwärme' with a total frontage of only around 400 yards as they attack a Group of eighteen B-17s.
71 Taylor (1980, 1992), Webster (1993, 1994).
72 Butterfield (1983b, 2009a), Knight (1996).
73 Ethell and Price (1981), pp.21–2, 69–83, Green (1980).
74 Ethell and Price (1981), pp.20–22, 69–83, Price (1998a), Ch. 16, Vasco and Cornwell (1995). The twin-engine P-38 (although its performance was often criticised) was nothing like as outclassed in air combat as the Me110. See Caidin (2001).
75 Ethell and Price (1994), Ch. 1.
76 Shaw (1986), pp.392–6.

77 Because of the square effect, the altitude equivalence should really be 1360 ft between speeds two and three, 1900 ft between speeds three and four, and 2440 ft between speeds four and five, but this variation is smoothed out in the game for the sake of simplicity.
78 Price (1982) gives a sense for the Spitfire of how climb rates varied with height and with technical improvements.
79 Shaw (1986), pp.394–412.
80 Shaw (1986), pp.387–92. Maximum rate turns in the game produce 1.7G at speed two, 3.8G at speed three, 5.1G at speed four, and 4.3G at speed five (calculated by multiplying the real speed by the turn rate in radians, and dividing by the acceleration due to gravity).
81 Lanchester (1995), Chs 5–6.
82 Bungay (2000), pp.368–76, Ethell and Price (1981), Chs 2–3, Spick (1983), pp.73–5.
83 Futrell (1983), Chs 9, 13, Morrow (1993), Spick (1983), Ch. 9, (1988), Ch. 1.
84 Ray (1994), Chs 4–5, Turner (1999).
85 Hardesty (1982), Sabin (2009a), Shores (1985), Ch. 10, Spick (1988), Chs 1 and 4.
86 Spick (1983), pp.75–6.
87 I use the same mechanism of variable unit sizes to an even greater extent in my *Lost Battles* system. See Sabin (2007a), pp.17–21.
88 Spick (1988), pp.17–31.
89 Butterfield (1983b, 2009a).
90 Hind (1980), Seaman (1995), Taylor (1980, 1993), Uhl (1987).
91 Spick (1983), pp.73–7.
92 Price (1989a), pp.114–6, Spick (1983), pp.25–7, 61, 84–6. Since they are only making two turns per round at a speed of two, fighters in a defensive circle do not lose energy and do not suffer from the firing penalty for high G manoeuvres.
93 Price (1989a), pp.104–7, Shaw (1986), Chs 5–8, Spick (1983), pp.43–4.
94 Price (1989a), pp.116–9, Spick (1983), pp.64, 92–5. Against enemy fighters, there was less stress on a long straight approach to head-on engagements, hence the success of the ‘Thach weave’ tactic in the Pacific against light Japanese Zeros. See Spick (1983), pp.86–91.
95 Middlebrook (1983), Ch. 13, Smith (1991), p.47.
96 Freeman (2001), pp.66–9, Price (1973), pp.118–9.
97 O’Ferrall, G.M. (1952) *Angels One Five*, Templar.

Notes on Conclusion

1 Biddle (2004), Lanchester (1995), Chs 5–6.
2 Interestingly, Lazenby sees a Punic victory after such a period of attrition and exhaustion as more plausible than a ‘blitz’ triumph after Cannae. See his remarks in Cornell, Rankov and Sabin (1996), pp.39–48.
3 Velicogna (2009). He may be seen running the closest game in the picture at the start of the colour plates.
4 Perla (1990), pp.183–4.
5 Dunnigan (1992), pp.25–3.
6 http://groups.yahoo.com/group/lostbattles/.
7 Sabin (2002a).
8 Perla (1990).

9 Fong (2006), Haldon et al. (2010), Halter (2006), McGonigal (2011), Moizer et al. (2009), Smith (2009b).
10 Sabin (2011a, 2011b).
11 Clausewitz (1976), p.86.

Notes on Appendices

1 Sabin (2007a), Sabin and Mahaffey (2011); http://www.fifthcolumngames.co.uk.
2 Palmer (1977, 1980b); http://www.omegagames.com/ (and use the 'PW CD ROM' link on the left of the Paper Wars page).
3 http://www.battlesmagazine.com/, http://vaevictis.histoireetcollections.com/.
4 http://www.bbc.co.uk/history/british/normans/launch_gms_battle_hastings.shtml.
5 Miranda (2007b).
6 Berg (1986), Clemente and McMillan (1976), Markham (1992).
7 Taylor (1982).
8 Sabin (2007a), pp.50–59, 70–71.
9 The chances are calculated as the multiple product of all the chances of that number of successes, times all the chances of the associated number of failures, times the number of different ways these successes and failures can be distributed across the total die rolls. Hence, the chance of achieving seven rolls of 3 or more in twelve die rolls is two-thirds to the power seven, times one-third to the power five, times 792. The last figure comes from constructing a pyramid based on increasing numbers of die rolls, with each figure being the sum of the two figures above it. Hence, for one roll the figures are (1,1), for two rolls (1,2,1), for three rolls (1,3,3,1), for four rolls (1,4,6,4,1), and so on. With twelve rolls, there are no fewer than 4096 different possible distributions of success and failure (which is two to the power twelve).
10 This also explains why the 1 in 36 chance of a farm appearing in each of the 48 hexes in *Fire and Movement* happened to produce no fewer than five farm hexes in the example in Chapter 11, instead of the expected average of just one or two.
11 Sabin and Mahaffey (2011).
12 Bostock and Chandler (1984), Grimmett and Stirzaker (1982).
13 Krzanowski (1988), Hillier and Lieberman (1995), Taha (1976).
14 Clausewitz (1976), p.86.

Bibliography

This bibliography is already fairly long, but it could have been far longer. My knowledge of recreational wargaming stems from extended study of over 1000 separate manual and computerised simulation games produced over the past 50 years, as well as an even larger number of issues of hobby magazines such as *Strategy & Tactics*, *The Wargamer*, *Command*, *Against the Odds*, *World at War*, *The General*, *Moves*, *Battle*, *Wargames Illustrated*, *Miniature Wargames*, *Slingshot*, *The Nugget*, *The Phoenix*, *Fire & Movement*, *Paper Wars*, *Vae Victis*, *Battles*, and several other titles. Similarly, my knowledge of the real events behind these wargames is based on insights from thousands of military history books in my personal library alone. The following listings are restricted purely to those works cited in the Notes to back up one or more specific points in the text and to underpin my own particular wargame designs.

To keep things simple, I have split the Bibliography into two sections. First, I list the simulation games themselves, using the appended notation '(PC)' to distinguish computerised from manual games. As with normal published works, I have used the designer's name as far as possible as the main identifying factor, although this is often problematic given the team-based process by which computer games in particular are produced, and it must be recognised that there are almost always numerous other individuals listed in the game credits besides a single specific designer. Games also often fail to specify a place of publication, so this detail may be vague or absent. The second section lists more conventional books and articles, although the mix of topics is far more eclectic than in other scholarly studies, and articles in hobby magazines like those just listed will be very difficult to find in standard libraries and will probably need to be obtained through the kind of second-hand dealers mentioned in Appendix 2.

SIMULATION GAMES

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